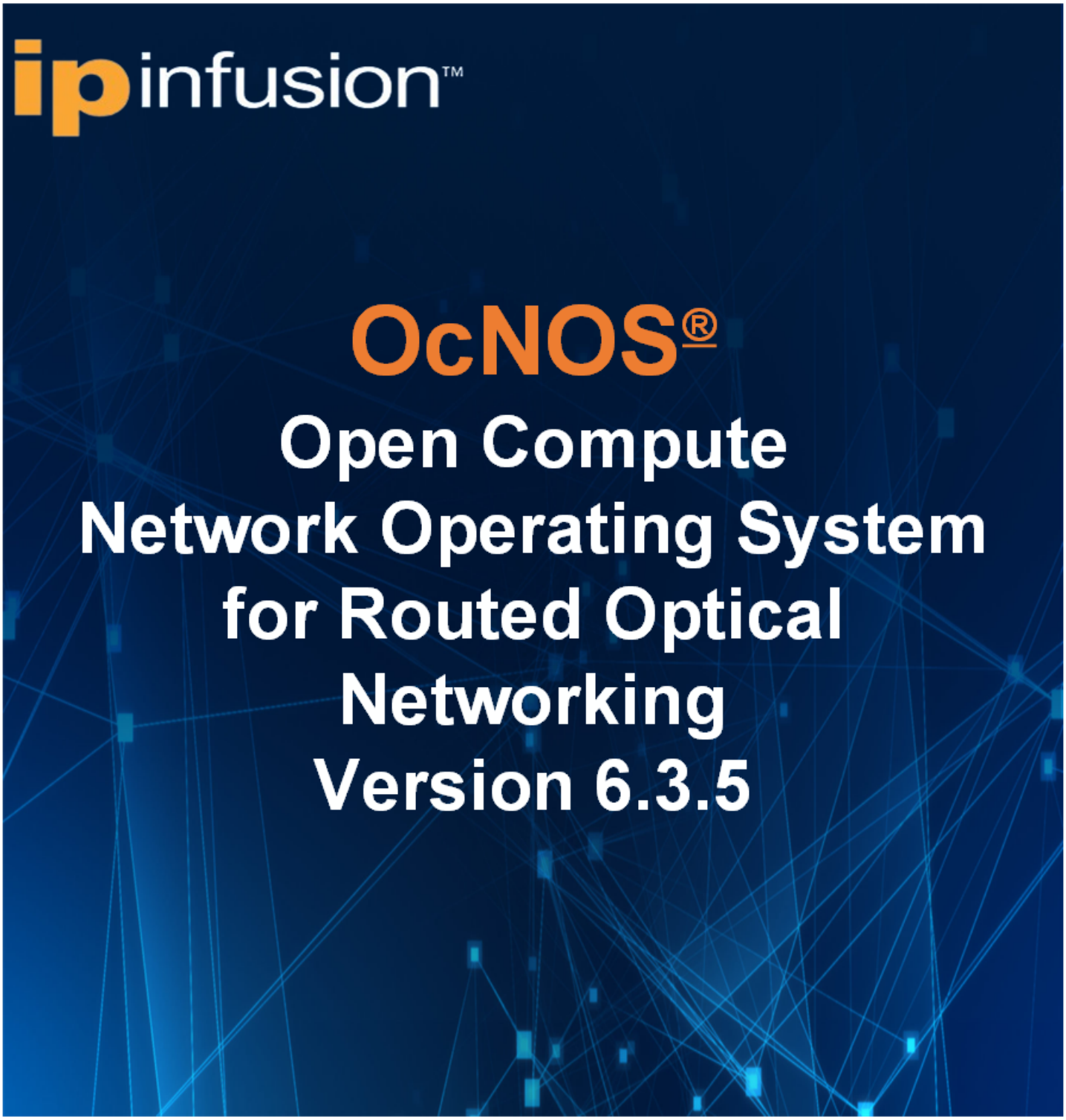

Layer 2 Guide

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Contents

Preface

This guide describes how to configure OcNOS.

IP Maestro Support

Monitor devices running OcNOS Release 6.3.4-70 and above using IP Maestro software.

Audience

This guide is intended for network administrators and other engineering professionals who configure OcNOS.

Conventions

Table 1 shows the conventions used in this guide.

Table 1: Conventions

Convention	Description
Italics	Emphasized terms; titles of books
Note:	Special instructions, suggestions, or warnings
`monospaced type`	Code elements such as commands, parameters, files, and directories

Chapter Organization

The chapters in command references are organized as described in Command Description Format.

The chapters in configuration guides are organized into these major sections:

- An overview that explains a configuration in words
- Topology with a diagram that shows the devices and connections used in the configuration
- Configuration steps in a table for each device where the left-hand side shows the commands you enter and the right-hand side explains the actions that the commands perform
- Validation which shows commands and their output that verify the configuration

Related Documentation

For information about installing of OcNOS, see the *Installation Guide* for your platform.

Migration Guide

Check the *Migration Guide* for configuration changes to make when migrating from one version of OcNOS to another.

Feature Availability

The features described in this document that are available depend upon the OcNOS SKU that you purchased. See the *Feature Matrix* for a description of the OcNOS SKUs.

Support

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Command Line Interface

This chapter introduces the OcNOS Command Line Interface (CLI) and how to use its features.

Overview

You use the CLI to configure, monitor, and maintain OcNOS devices. The CLI is text-based and each command is usually associated with a specific task.

You can give the commands described in this manual locally from the console of a device running OcNOS or remotely from a terminal emulator such as `putty` or `xterm`. You can also use the commands in scripts to automate configuration tasks.

Command Line Interface Help

You access the CLI help by entering a full or partial command string and a question mark “?”. The CLI displays the command keywords or parameters along with a short description. For example, at the CLI command prompt, type:

```
> show ?
```

The CLI displays this keyword list with short descriptions for each keyword:

```
show ?
  application-priority            Application Priority
  arp                             Internet Protocol (IP)
  bfd                             Bidirectional Forwarding Detection (BFD)
  bgp                             Border Gateway Protocol (BGP)
  bi-lsp                          Bi-directional lsp status and configuration
  bridge                          Bridge group commands
  ce-vlan                         COS Preservation for Customer Edge VLAN
  class-map                       Class map entry
  cli                             Show CLI tree of current mode
  clns                            Connectionless-Mode Network Service (CLNS)
  control-adjacency               Control Adjacency status and configuration
  control-channel                 Control Channel status and configuration
  cspf                            CSPF Information
  customer                        Display Customer spanning-tree
  cvlan                           Display CVLAN information
  debugging                       Debugging functions (see also 'undebug')
  etherchannel                    LACP etherchannel
  ethernet                        Layer-2
...
```

If you type the ? in the middle of a keyword, the CLI displays help for that keyword only.

```
> show de?
debugging  Debugging functions (see also 'undebug')
```

If you type the ? in the middle of a keyword, but the incomplete keyword matches several other keywords, OcNOS displays help for all matching keywords.

```
> show i? (CLI does not display the question mark).
interface  Interface status and configuration
ip         IP information
isis       ISIS information
```

Command Completion

The CLI can complete the spelling of a command or a parameter. Begin typing the command or parameter and then press the tab key. For example, at the CLI command prompt type `sh`:

```
> sh
```

Press the tab key. The CLI displays:

```
> show
```

If the spelling of a command or parameter is ambiguous, the CLI displays the choices that match the abbreviation. Type `show i` and press the tab key. The CLI displays:

```
> show i
  interface  ip         ipv6       isis
> show i
```

The CLI displays the `interface` and `ip` keywords. Type `n` to select `interface` and press the tab key. The CLI displays:

```
> show in
> show interface
```

Type ? and the CLI displays the list of parameters for the `show interface` command.

```
> show interface
  IFNAME  Interface name
  |       Output modifiers
  >       Output redirection
  <cr>
```

The CLI displays the only parameter associated with this command, the `IFNAME` parameter.

Command Abbreviations

The CLI accepts abbreviations that uniquely identify a keyword in commands. For example:

```
> sh int xe0
```

is an abbreviation for:

```
> show interface xe0
```

Command Line Errors

Any unknown spelling causes the CLI to display the error `Unrecognized command` in response to the ?. The CLI displays the command again as last entered.

```
> show dd?
% Unrecognized command
> show dd
```

When you press the Enter key after typing an invalid command, the CLI displays:

```
(config)#router ospf here
                        ^
% Invalid input detected at '^' marker.
```

where the ^ points to the first character in error in the command.

If a command is incomplete, the CLI displays the following message:

```
> show
% Incomplete command.
```

Some commands are too long for the display line and can wrap mid-parameter or mid-keyword, as shown below. This does *not* cause an error and the command performs as expected:

```
area 10.10.0.18 virtual-link 10.10.0.19 authent
ication-key 57393
```

Command Negation

Many commands have a `no` form that resets a feature to its default value or disables the feature. For example:

- The `ip address` command assigns an IPv4 address to an interface
- The `no ip address` command removes an IPv4 address from an interface

Syntax Conventions

Table 1 describes the conventions used to represent command syntax in this reference.

Table 1: Syntax conventions

Convention	Description	Example
`monospaced font`	Command strings entered on a command line	`show ip ospf`
`lowercase`	Keywords that you enter exactly as shown in the command syntax.	`show ip ospf`
`UPPERCASE`	See Variable Placeholders	`IFNAME`
`()`	Optional parameters, from which you must select one. Vertical bars delimit the selections. Do not enter the parentheses or vertical bars as part of the command.	`(A.B.C.D|<0-4294967295>)`
`()`	Optional parameters, from which you select one or none. Vertical bars delimit the selections. Do not enter the parentheses or vertical bars as part of the command.	`(A.B.C.D|<0-4294967295>|)`
`()`	Optional parameter which you can specify or omit. Do not enter the parentheses or vertical bar as part of the command.	`(IFNAME|)`
`{}`	Optional parameters, from which you must select one or more. Vertical bars delimit the selections. Do not enter the braces or vertical bars as part of the command.	`{intra-area <1-255>|inter-area <1-255>|external <1-255>}`

Table 1: Syntax conventions (Continued)

Convention	Description	Example
`[]`	Optional parameters, from which you select zero or more. Vertical bars delimit the selections. Do not enter the brackets or vertical bars as part of the command.	`[<1-65535>|AA:NN|internet|local-AS|no-advertise|no-export]`
`?`	Nonrepeatable parameter. The parameter that follows a question mark can only appear once in a command string. Do not enter the question mark as part of the command.	`?route-map WORD`
`.`	Repeatable parameter. The parameter that follows a period can be repeated more than once. Do not enter the period as part of the command.	`set as-path prepend .<1-65535>`

Variable Placeholders

Table 2 shows the tokens used in command syntax use to represent variables for which you supply a value.

Table 2: Variable placeholders

Token	Description
`WORD`	A contiguous text string (excluding spaces)
`LINE`	A text string, including spaces; no other parameters can follow this parameter
`IFNAME`	Interface name whose format varies depending on the platform; examples are: `eth0`, `Ethernet0`, `ethernet0`, `xe0`
`A.B.C.D`	IPv4 address
`A.B.C.D/M`	IPv4 address and mask/prefix
`X:X::X:X`	IPv6 address
`X:X::X:X/M`	IPv6 address and mask/prefix
`HH:MM:SS`	Time format
`AA:NN`	BGP community value
`XX:XX:XX:XX:XX:XX`	MAC address

`<1-5>`
`<1-65535>`
`<0-2147483647>`
`<0-4294967295>`
	Numeric range

Command Description Format

Table 3 explains the sections used to describe each command in this reference.

Table 3: Command descriptions

Section	Description
Command Name	The name of the command, followed by what the command does and when should it be used
Command Syntax	The syntax of the command
Parameters	Parameters and options for the command
Default	The state before the command is executed
Command Mode	The mode in which the command runs; see Command Modes
Example	An example of the command being executed

Keyboard Operations

Table 4 lists the operations you can perform from the keyboard.

Table 4: Keyboard operations

Key combination	Operation
Left arrow or Ctrl+b	Moves one character to the left. When a command extends beyond a single line, you can press left arrow or Ctrl+b repeatedly to scroll toward the beginning of the line, or you can press Ctrl+a to go directly to the beginning of the line.
Right arrow or Ctrl-f	Moves one character to the right. When a command extends beyond a single line, you can press right arrow or Ctrl+f repeatedly to scroll toward the end of the line, or you can press Ctrl+e to go directly to the end of the line.
Esc, b	Moves back one word
Esc, f	Moves forward one word
Ctrl+e	Moves to end of the line
Ctrl+a	Moves to the beginning of the line
Ctrl+u	Deletes the line
Ctrl+w	Deletes from the cursor to the previous whitespace
Alt+d	Deletes the current word
Ctrl+k	Deletes from the cursor to the end of line
Ctrl+y	Pastes text previously deleted with Ctrl+k, Alt+d, Ctrl+w, or Ctrl+u at the cursor

Table 4: Keyboard operations (Continued)

Key combination	Operation
Ctrl+t	Transposes the current character with the previous character
Ctrl+c	Ignores the current line and redisplays the command prompt
Ctrl+z	Ends configuration mode and returns to exec mode
Ctrl+l	Clears the screen
Up Arrow or Ctrl+p	Scroll backward through command history
Down Arrow or Ctrl+n	Scroll forward through command history

Show Command Modifiers

You can use two tokens to modify the output of a `show` command. Enter a question mark to display these tokens:

```
# show users ?
  | Output modifiers
  > Output redirection
```

You can type the | (vertical bar character) to use output modifiers. For example:

```
> show rsvp | ?
  begin     Begin with the line that matches
  exclude   Exclude lines that match
  include   Include lines that match
  last      Last few lines
  redirect  Redirect output
```

Begin Modifier

The `begin` modifier displays the output beginning with the first line that contains the input string (everything typed after the `begin` keyword). For example:

```
# show running-config | begin xe1
...skipping
interface xe1
 ipv6 address fe80::204:75ff:fee6:5393/64
!
interface xe2
 ipv6 address fe80::20d:56ff:fe96:725a/64
!
line con 0
 login
!
end
```

You can specify a regular expression after the `begin` keyword, This example begins the output at a line with either “xe2” or “xe4”:

```
# show running-config | begin xe[3-4]

...skipping
```

```
interface xe3
 shutdown
!
interface xe4
 shutdown
!
interface svlan0.1
 no shutdown
!
route-map myroute permit 3
!
route-map mymap1 permit 10
!
route-map rmap1 permit 3
!
line con 0
 login
line vty 0 4
 login
!
end
```

Include Modifier

The `include` modifier includes only those lines of output that contain the input string. In the output below, all lines containing the word “input” are included:

```
# show interface xe1 | include input
    input packets 80434552, bytes 2147483647, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 1, missed 0
```

You can specify a regular expression after the `include` keyword. This examples includes all lines with “input” or “output”:

```
#show interface xe0 | include (in|out)put
    input packets 597058, bytes 338081476, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 0, missed 0
    output packets 613147, bytes 126055987, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
```

Exclude Modifier

The `exclude` modifier excludes all lines of output that contain the input string. In the following output example, all lines containing the word “input” are excluded:

```
# show interface xe1 | exclude input
Interface xe1
  Scope: both
  Hardware is Ethernet, address is 0004.75e6.5393
  index 3 metric 1 mtu 1500 <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  Administrative Group(s): None
  DSTE Bandwidth Constraint Mode is MAM
  inet6 fe80::204:75ff:fee6:5393/64
    output packets 4438, bytes 394940, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
    collisions 0
```

You can specify a regular expression after the `exclude` keyword. This example excludes lines with “output” or “input”:

```
# show interface xe0 | exclude (in|out)put
Interface xe0
  Scope: both
  Hardware is Ethernet  Current HW addr: 001b.2139.6c4a
  Physical:001b.2139.6c4a  Logical:(not set)
  index 2 metric 1 mtu 1500 duplex-full arp ageing timeout 3000
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  Bandwidth 100m
  DHCP client is disabled.
  inet 10.1.2.173/24 broadcast 10.1.2.255
  VRRP Master of :  VRRP is not configured on this interface.
  inet6 fe80::21b:21ff:fe39:6c4a/64
    collisions 0
```

Redirect Modifier

The `redirect` modifier writes the output into a file. The output is not displayed.

```
# show cli history | redirect /var/frame.txt
```

The output redirection token (>) does the same thing:

```
# show cli history >/var/frame.txt
```

Last Modifier

The `last` modifier displays the output of last few number of lines (As per the user input). The last number ranges from 1 to 9999.

For example:

```
#show running-config | last 10
```

String Parameters

The restrictions in Table 5 apply for all string parameters used in OcNOS commands, unless some other restrictions are noted for a particular command.

Table 5: String parameter restrictions

Restriction	Description
Input length	1965 characters or less
Restricted special characters	“?”, “,”, “>”, “|”, and “=” The “|” is allowed only for `description` CLI in interface mode.

Command Modes

Commands are grouped into modes arranged in a hierarchy. Each mode has its own set of commands. Table 6 lists the command modes common to all protocols.

Table 6: Common command modes

Name	Description
Executive mode	Also called *view* mode, this is the first mode to appear after you start the CLI. It is a base mode from where you can perform basic commands such as `show`, `exit`, `quit`, `help`, and `enable`.
Privileged executive mode	Also called *enable* mode, in this mode you can run additional basic commands such as `debug`, `write`, and `show`.
Configure mode	Also called *configure terminal* mode, in this mode you can run configuration commands and go into other modes such as interface, router, route map, key chain, and address family. Configure mode is single user. Only one user at a time can be in configure mode.
Interface mode	In this mode you can configure protocol-specific settings for a particular interface. Any setting you configure in this mode overrides a setting configured in router mode.
Router mode	This mode is used to configure router-specific settings for a protocol such as BGP or OSPF.

Command Mode Tree

The diagram below shows the common command mode hierarchy.

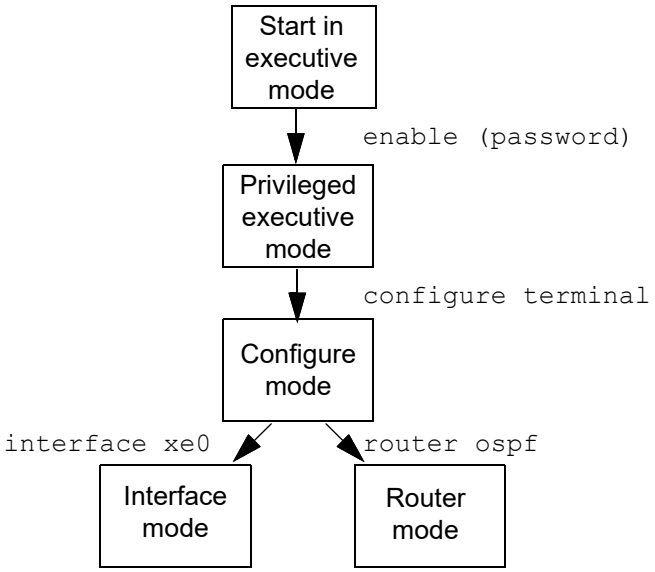


Figure 4-1: Common command modes

To change modes:

1. Enter privileged executive mode by entering `enable` in Executive mode.
2. Enter configure mode by entering `configure terminal` in Privileged Executive mode.

The example below shows moving from executive mode to privileged executive mode to configure mode and finally to router mode:

```
> enable mypassword
# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
(config)# router ospf
(config-router)#
```

Note: Each protocol can have modes in addition to the common command modes. See the command reference for the respective protocol for details.

Transaction-based Command-line Interface

The OcNOS command line interface is transaction based:

- Any changes done in configure mode are stored in a separate *candidate* configuration that you can view with the show transaction current command.
- When a configuration is complete, apply the candidate configuration to the running configuration with the commit command.
- If a commit fails, no configuration is applied as the entire transaction is considered failed. You can continue to change the candidate configuration and then retry the commit.
- Discard the candidate configuration with the abort transaction command.
- Check the last aborted transaction with the show transaction last-aborted command.
- Multiple configurations cannot be removed with a single commit. You must remove each configuration followed by a commit.

Note: All commands MUST be executed only in the default CML shell (`cmlsh`). If you log in as `root` and start `imish`, then the system configurations will go out of sync. The imish shell is not supported and should not be started manually.

Layer 2 Configuration Guide

CHAPTER 1 VLAN Configuration

This chapter contains a complete VLAN configuration.

Configuring VLAN Tags

Topology

This shows configuring a VLAN bridge with VLAN tags on forwarding frames. Link between Bridge 1 and Bridge 2 is configured as VLAN 5 and link between Bridge 3 and Bridge 1 is configured as VLAN 10. Link between Bridge 2 and Bridge 3 is configured with VLAN 5 and VLAN 10.

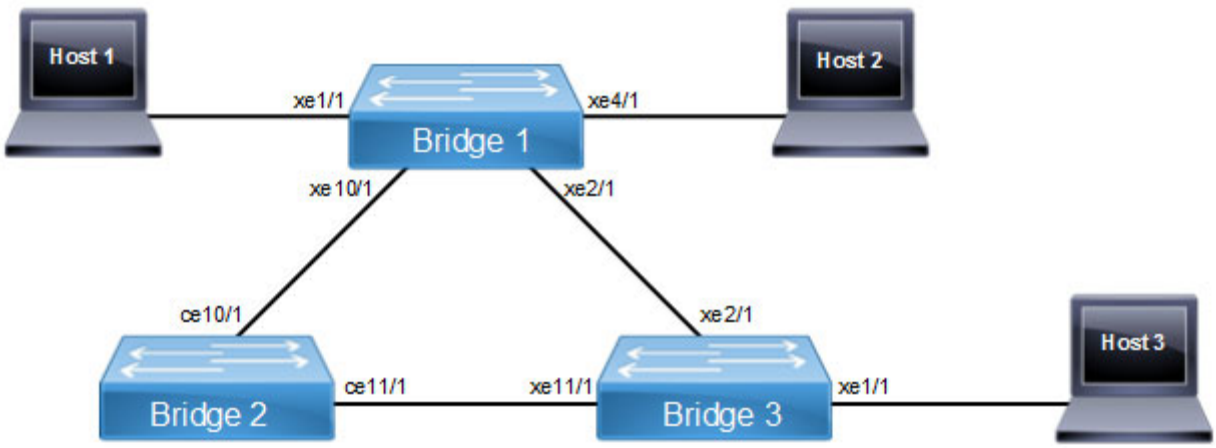


Figure 6-1: VLAN Topology

Note: Run the `switchport` command on each port to change to Layer-2 mode.

Bridge 1

`Bridge1#configure terminal`	Enter configuration mode
`Bridge1(config)#bridge 1 protocol ieee vlan-bridge`	Specify VLAN for bridge 1.
`Bridge1(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge1(config-vlan)#vlan 5 bridge 1 state enable`	Enable VLAN (5) on bridge 1.Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge1(config-vlan)#vlan 10 bridge 1 state enable`	Enable VLAN (10) on bridge 1. Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge1(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge1(config)#interface xe1/1`	Enter interface mode.
`Bridge1(config-if)#switchport`	Configure port as L2.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group 1.
`Bridge1(config-if)#switchport mode access`	Set the switching characteristics of this interface to access mode.
`Bridge1(config-if)#switchport access vlan 5`	Enable VLAN ID 5 on this port.

`Bridge1(config-if)#exit`	Exit the interface mode and go config mode.
`Bridge1(config)#interface xe2/1`	Enter interface mode.
`Bridge1(config-if)#switchport`	Configure port as L2.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group 1.
`Bridge1(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge1(config-if)#switchport trunk allowed vlan add 10`	Enable VLAN ID 10 on this port.
`Bridge1(config-if)#exit`	Exit from the interface mode and go config mode.
`Bridge1(config)#interface xe4/1`	Enter interface mode.
`Bridge1(config-if)#switchport`	Configure port as L2.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group 1.
`Bridge1(config-if)#switchport mode access`	Set the switching characteristics of this interface to access mode.
`Bridge1(config-if)#switchport access vlan 10`	Enable VLAN ID 10 on this port.
`Bridge1(config-if)#exit`	Exit from the interface mode and go config mode.
`Bridge1(config)#interface xe10/1`	Enter interface mode.
`Bridge1(config-if)#switchport`	Configure port as L2.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group 1.
`Bridge1(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge1(config-if)#switchport trunk allowed vlan add 5`	Enable VLAN ID 5 on this port.
`Bridge1(config-if)#exit`	Exit from the interface mode and go config mode.

Bridge 2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#bridge 2 protocol ieee vlan-bridge`	Specify VLAN for bridge 2.
`Bridge2(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge2(config-vlan)#vlan 5 bridge 2 state enable`	Enable VLAN (5) on bridge 2. Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge2(config-vlan)#vlan 10 bridge 2 state enable`	Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge2(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge2(config)#interface ce10/1`	Enter interface mode.
`Bridge2(config-if)#switchport`	
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group 2.
`Bridge2(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge2(config-if)#switchport access vlan 5`	Enable VLAN port access by specifying the VLAN ID 5 on this interface.
`Bridge2(config-if)#switchport trunk allowed vlan add 10`	Enable VLAN ID 10 on this port.

`Bridge2(config-if)#switchport`	Configure port as L2.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group 2.
`Bridge2(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge2(config-if)#switchport trunk allowed vlan add 5`	Enable VLAN ID 5 on this port.
`Bridge2(config-if)#switchport trunk allowed vlan add 10`	Enable VLAN ID 10 on this port.
`Bridge2(config-if)#exit`	Exit from the interface mode and go config mode.
`Bridge2(config)#interface ce11/1`	Enter interface mode.
`Bridge2(config-if)#switchport`	Configure port as L2.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group 2.
`Bridge2(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge2(config-if)#switchport trunk allowed vlan add 5`	Enable VLAN ID 5 on this port.
`Bridge2(config-if)#switchport trunk allowed vlan add 10`	Enable VLAN ID 10 on this port.
`Bridge1(config-if)#exit`	Exit from the interface mode and go config mode.

Bridge 3

`Bridge3#configure terminal`	Enter configure mode.
`Bridge3(config)#bridge 3 protocol ieee vlan-bridge`	Specify VLAN for bridge 3.
`Bridge3(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge3(config-vlan)#vlan 5 bridge 3 state enable`	Enable VLAN (5) on bridge 3. Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge3(config-vlan)#vlan 10 bridge 3 state enable`	Enable VLAN (10) on bridge 3. Specifying the enable state allows forwarding of frames on this VLAN-aware bridge.
`Bridge3(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge3(config)#interface xe1/1`	Enter interface mode.
`Bridge3(config-if)#switchport`	Configure port as L2.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group 3.
`Bridge3(config-if)#switchport mode access`	Set the switching characteristics of this interface to access mode.
`Bridge3(config-if)#switchport access vlan 5`	Enable VLAN ID 5 on this port.
`Bridge3(config-if)#switchport access vlan 10`	Enable VLAN ID 10 on this port.
`Bridge3(config-if)#exit`	Exit from the interface mode and go config mode.
`Bridge3(config)#interface xe2/1`	Enter interface mode.
`Bridge3(config-if)#switchport`	Configure port as L2.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group 3.
`Bridge3(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.

`Bridge3(config-if)#switchport trunk allowed vlan add 10`	Enable VLAN ID 10 on this port.
`Bridge3(config-if)#exit`	Exit from the interface mode and go config mode.
`Bridge3(config)#interface xe11/1`	Enter interface mode.
`Bridge3(config-if)#switchport`	Configure port as L2.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group 3.
`Bridge3(config-if)#switchport mode trunk`	Set the switching characteristics of this interface to trunk mode.
`Bridge3(config-if)#switchport trunk allowed vlan add 5`	Enable VLAN ID 5 on this port.
`Bridge3(config-if)#exit`	Exit from the interface mode and go config mode.

Validation

Bridge 1

```
Bridge1#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled
% 1: Root Path Cost 1 - Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 - Root port 909
% 1: Root Id 8000001823304db6
% 1: Bridge Id 8000001823305244
% 1: 6 topology changes - last topology change Fri Apr 19 12:32:26 2019
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   xe1/1: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - path cost 4 - designated
cost 1
%   xe1/1: Designated Port Id 0x8389 - state Forwarding -Priority 128
%   xe1/1: Designated root 8000001823304db6
%   xe1/1: Designated Bridge 8000001823305244
%   xe1/1: Message Age 1 - Max Age 20
%   xe1/1: Hello Time 2 - Forward Delay 15
%   xe1/1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   xe1/1: forward-transitions 1
%   xe1/1: No portfast configured - Current  portfast off
%   xe1/1: bpdu-guard  default  - Current bpdu-guard off
%   xe1/1: bpdu-filter default  - Current bpdu-filter off
%   xe1/1: no root guard configured     - Current root guard off
%
%   xe2/1: Port Number 909 - Ifindex 5005 - Port Id 0x838d - path cost 1 - designated
cost 0
%   xe2/1: Designated Port Id 0x838d - state Forwarding -Priority 128
%   xe2/1: Designated root 8000001823304db6
%   xe2/1: Designated Bridge 8000001823304db6
%   xe2/1: Message Age 0 - Max Age 20
%   xe2/1: Hello Time 2 - Forward Delay 15
%   xe2/1: Forward Timer 0 - Msg Age Timer 19 - Hello Timer 0 - topo change timer 0
%   xe2/1: forward-transitions 2
```

```
%   xe2/1: No portfast configured - Current  portfast off
%   xe2/1: bpdu-guard  default  - Current bpdu-guard off
%   xe2/1: bpdu-filter default  - Current bpdu-filter off
%   xe2/1: no root guard configured     - Current root guard off
%
%   xe4/1: Port Number 917 - Ifindex 5013 - Port Id 0x8395 - path cost 4 - designated
cost 1
%   xe4/1: Designated Port Id 0x8395 - state Forwarding -Priority 128
%   xe4/1: Designated root 8000001823304db6
%   xe4/1: Designated Bridge 8000001823305244
%   xe4/1: Message Age 1 - Max Age 20
%   xe4/1: Hello Time 2 - Forward Delay 15
%   xe4/1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change timer 0
%   xe4/1: forward-transitions 1
%   xe4/1: No portfast configured - Current  portfast off
%   xe4/1: bpdu-guard  default  - Current bpdu-guard off
%   xe4/1: bpdu-filter default  - Current bpdu-filter off
%   xe4/1: no root guard configured     - Current root guard off
%
%   xe10/1: Port Number 941 - Ifindex 5037 - Port Id 0x83ad - path cost 2 - designated
cost 1
%   xe10/1: Designated Port Id 0x83ad - state Forwarding -Priority 128
%   xe10/1: Designated root 8000001823304db6
%   xe10/1: Designated Bridge 8000001823305244
%   xe10/1: Message Age 1 - Max Age 20
%   xe10/1: Hello Time 2 - Forward Delay 15
%   xe10/1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   xe10/1: forward-transitions 2
%   xe10/1: No portfast configured - Current  portfast off
%   xe10/1: bpdu-guard  default  - Current bpdu-guard off
%   xe10/1: bpdu-filter default  - Current bpdu-filter off
%   xe10/1: no root guard configured     - Current root guard off
%
B1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         1                   xe2/1       0018.23cb.fbbc    1     300
 1         1                   xe10/1      cc37.ab97.37d8    1     300
 1         5                   xe1/1       0000.11bc.5dec    1     300
 1         10                  xe4/1       0000.2d50.205c    1     300
Bridge1#


Bridge1#show vlan all bridge 1
Bridge  VLAN ID     Name         State   H/W Status      Member ports
                                                         (u)-Untagged, (t)-Tagged
======= ======= ================ ======= ========== ==========================
1       1       default          ACTIVE  Success    xe1/1(u) xe2/1(u) xe4/1(u)
                                                    xe10/1(u)
```

```
1       5       VLAN0005         ACTIVE  Success    xe1/1(t) xe10/1(t)
1       10      VLAN0010         ACTIVE  Success    xe2/1(t) xe4/1(t)


Bridge1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         1                   xe2/1       0018.23cb.fbbc    1     300
 1         1                   xe10/1      cc37.ab97.37d8    1     300
 1         5                   xe1/1       0000.11bc.5dec    1     300
 1         10                  xe4/1       0000.2d50.205c    1     300
Bridge1#
```

Bridge 2

```
Bridge2#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 2         1                   ce10/1      0018.2326.166a    1     300
 2         1                   ce11/1      0018.23cb.fbe0    1     300
 2         1                   ce11/1      cc37.ab97.37d8    1     300
 2         5                   ce10/1      0000.11bc.5dec    1     300


Bridge2#show vlan all bridge 2
Bridge  VLAN ID     Name         State   H/W Status      Member ports
                                                      (u)-Untagged, (t)-Tagged
======= ======= ================ ======= ========== ===========================
2       1       default          ACTIVE  Success    ce10/1(u) ce11/1(u)
2       5       VLAN0005         ACTIVE  Success    ce10/1(t) ce11/1(t)
2       10      VLAN0010         ACTIVE  Success    ce10/1(t) ce11/1(t)


Bridge2#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 2         1                   ce10/1      0018.2326.166a    1     300
 2         1                   ce11/1      0018.23cb.fbe0    1     300
 2         1                   ce11/1      cc37.ab97.37d8    1     300
 2         5                   ce10/1      0000.11bc.5dec    1     300
```

Bridge 3

```
Bridge3#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
```

```
 ---------+------+------+------+-----------+-----------------+-----+---------+
 3         1                   xe2/1       cc37.ab97.37d8    1     300
 3         5                   xe11/1      0000.11bc.5dec    1     300
 3         10                  xe2/1       0000.2d50.205c    1     300
Bridge3#show vlan all bridge 3
Bridge  VLAN ID     Name         State   H/W Status      Member ports
                                                        (u)-Untagged, (t)-Tagged
======= ======= ================ ======= ========== ==========================
3       1       default          ACTIVE  Success    xe1/1(u) xe2/1(u) xe11/1(u)
3       5       VLAN0005         ACTIVE  Success    xe1/1(t) xe11/1(t)
3       10      VLAN0010         ACTIVE  Success    xe1/1(t) xe2/1(t)


Bridge3#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 3         1                   xe2/1       cc37.ab97.37d8    1     300
 3         5                   xe11/1      0000.11bc.5dec    1     300
 3         10                  xe2/1       0000.2d50.205c    1     300
Bridge3#
```

CHAPTER 2 Disabling Native VLAN Configuration on Trunk mode

This chapter contains sample configurations to check the functionality to drop the untagged traffic by disabling the native VLAN by configuring acceptable-frame-type VLAN-tagged.

Topology

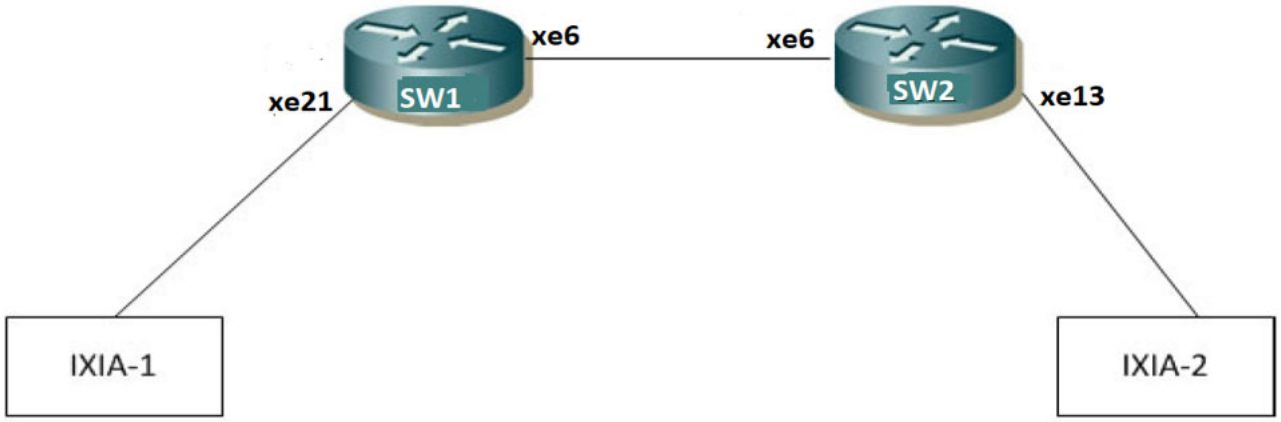


Figure 2-2: Native VLAN Topology

Configuration

SW1

`SW1#configure terminal`	Enter configuration mode
`SW1(config)#bridge 1 protocol mstp`	Create bridge
`SW1(config)#vlan database`	Enter VLAN configuration mode
`SW1(config-vlan)#vlan 2-10 bridge 1 state enable`	Create 2-10 vlans
`SW1(config-vlan)#exit`	Exit VLAN configuration mode
`SW1(config)#interface xe21`	Enter interface configuration mode for xe21
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode trunk`	Configure port mode as trunk
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the xe21 port
`SW1(config-if)#exit`	Exit from interface mode
`SW1(config)#interface xe6`	Enter interface configuration mode for xe6
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1

`SW1(config-if)#switchport mode trunk`	Configure port mode as trunk
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the xe6 port
`SW1(config-if)#exit`	Exit from interface mode
`SW1(config)#commit`	Commit the candidate configuration to the running configuration

SW2

`SW2#configure terminal`	Enter configuration mode
`SW2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge
`SW2(config)#vlan database`	Enter VLAN configuration mode
`SW2(config-vlan)#vlan 2-10 bridge 1 state enable`	Create 2-10 vlans
`SW2(config-vlan)#exit`	Exit VLAN configuration mode
`SW2(config)#interface xe6`	Enter interface configuration mode for xe6
`SW2(config-if)#switchport`	Configure switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode trunk`	Configure port mode as trunk
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the xe6 port
`SW2(config-if)#exit`	Exit from interface mode
`SW2(config)#interface xe13`	Enter interface configuration mode for xe13
`SW2(config-if)#switchport`	Configure switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode trunk`	Configure port mode as trunk
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the xe13 port
`SW2(config-if)#exit`	Exit from interface mode
`SW2(config)#commit`	Commit the candidate configuration to the running configuration

Validation

Sending untagged, VLAN-5 and VLAN-6 traffic from IXIA-1 to IXIA-2. In the show bridge o/p we can see all the MAC entries learnt for all the traffics.

In the `show vlan brief` output for default VLAN interface xe21 is having port type as untagged (u).

```
SW1#show bridge
bridge 1 is running on mstp
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+------------+------------------+-----+---------+
 1         1                   ce2/2        0010.9400.0001     1     300
```

```
SW1#show interface counters rate mbps
+------------------+-------------+------------+-------------+-------------+
|     Interface    |    Rx mbps  |    Rx pps  |    Tx mbps  |    Tx pps   |
+------------------+-------------+------------+-------------+-------------+
 xe21               621.21        606650       0.00          0
 xe6                0.00          0            621.21        606651

SW1#show vlan brief
Bridge  VLAN ID     Name          State   H/W Status      Member ports
                                                        (u)-Untagged, (t)-Tagged
======= ======= ================ ======= ========== ==========================
1       1       default          ACTIVE  Success    xe21(u) xe6(u)
1       2       VLAN0002         ACTIVE  Success    xe21(t) xe6(t)
1       3       VLAN0003         ACTIVE  Success    xe21(t) xe6(t)
1       4       VLAN0004         ACTIVE  Success    xe21(t) xe6(t)
1       5       VLAN0005         ACTIVE  Success    xe21(t) xe6(t)
1       6       VLAN0006         ACTIVE  Success    xe21(t) xe6(t)
1       7       VLAN0007         ACTIVE  Success    xe21(t) xe6(t)
1       8       VLAN0008         ACTIVE  Success    xe21(t) xe6(t)
1       9       VLAN0009         ACTIVE  Success    xe21(t) xe6(t)
1       10      VLAN0010         ACTIVE  Success    xe21(t) xe6(t)
```

Configuring Disable-Native-VLAN on Trunk mode

SW1

`SW1(config)#interface xe21`	Enter interface configuration mode for xe21
`SW1(config-if)#switchport mode trunk disable-native-vlan`	Configure disable native VLAN on trunk mode
`SW1(config-if)#exit`	Exit from interface mode
`SW1(config)#commit`	Commit the candidate configuration to the running configuration

Validation

After configuring disable-native-vlan, `show vlan brief` output we can see that xe21 interface is having port type as tagged (t).

```
SW1#show bridge
bridge 1 is running on mstp
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+


SW1#sh vlan brief
bridge 1 is running on rstp vlan-bridge
Ageout time is global and if something is configured for vxlan then it will be a
```

```
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         1                   xe21         0000.0000.0001    1     300
 1         5                   xe21         0000.0000.0005    1     300

SW1#show interface counters rate mbps
+-------------------+--------------+-------------+--------------+-------------+
|     Interface     |    Rx mbps   |    Rx pps   |    Tx mbps   |    Tx pps   |
+-------------------+--------------+-------------+--------------+-------------+
 xe21               864.88         844613        0.00           0
 xe6                0.00           0             0.00           0

SW1#show interface counters drop-stats
Interface ce2/2
  Rx Policy Discards: 454522965
  Rx EGR Port Unavail: 454522967
```

CHAPTER 3 Spanning Tree Protocol Configuration

This chapter contains a complete sample STP configuration. STP prevents duplication of packets by eliminating loops in the network.

Topology

The following example is a simple multi-bridge topology.

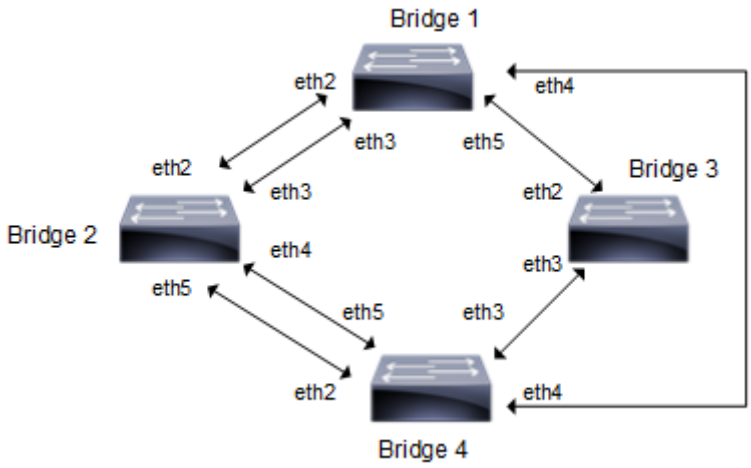


Figure 3-3: STP Topology

Note: Run the `switchport` command on each port to change to Layer-2 mode.

Configurations

Bridge 1

`Bridge1#configure terminal`	Enter configure mode.
`Bridge1(config)#bridge 1 protocol ieee`	Add a bridge `(1)` to the spanning tree table
`Bridge1(config)#interface eth2`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth3`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth4`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth5`	Enter interface mode
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.

Bridge 2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#bridge 2 protocol ieee`	Add a bridge (`2`) to the spanning tree table
`Bridge2(config)#interface eth2`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth3`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth4`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth5`	Enter interface mode
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.

Bridge 4

`Bridge4#configure terminal`	Enter configure mode.
`Bridge4(config)#bridge 4 protocol ieee`	Add a bridge (`4`) to the spanning tree table
`Bridge4(config)#interface eth2`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth3`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth4`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth5`	Enter interface mode
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.

Bridge 3

`Bridge3#configure terminal`	Enter configure mode.
`Bridge3(config)#bridge 3 protocol ieee`	Add a bridge `(3)` to the spanning tree table
`Bridge3(config)#interface eth2`	Enter interface mode.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group `3`.
`Bridge3(config-if)#exit`	Exit interface mode.
`Bridge3(config)#interface eth3`	Enter interface mode.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group `3`.

Validation

show spanning-tree, show spanning-tree interface <if-name>

Bridge 1

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8000525400244323
% 1: Bridge Id 8000525400244323
% 1: last topology change Mon Mar  4 11:40:41 2019
% 1: 20 topology change(s)  - last topology change Mon Mar  4 11:40:41 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400244323
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth2: forward-transitions 1
%   eth2: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
```

```
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 0
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400244323
%   eth3: Message Age 0 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 0
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400244323
%   eth4: Message Age 0 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%
#

#show spanning-tree interface eth1
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8000525400244323
% 1: Bridge Id 8000525400244323
% 1: last topology change Mon Mar  4 11:40:41 2019
% 1: 20 topology change(s)  - last topology change Mon Mar  4 11:40:41 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
```

```
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
#
```

Bridge 2

```
#show spanning-tree
% 2: Bridge up - Spanning Tree Enabled  - topology change detected
% 2: Root Path Cost 20000 - Root Port 3 -  Bridge Priority 32768
% 2: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 2: Root Id 8000525400244323
% 2: Bridge Id 8000525400d15789
% 2: last topology change Mon Mar  4 11:40:43 2019
% 2: 11 topology change(s)  - last topology change Mon Mar  4 11:40:43 2019

% 2: portfast bpdu-filter disabled
% 2: portfast bpdu-guard disabled
% 2: portfast errdisable timeout disabled
% 2: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
```

```
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400244323
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 1 - topo change
timer 0
%   eth2: forward-transitions 0
%   eth2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 20000
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400d15789
%   eth3: Message Age 1 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 20000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400d15789
%   eth4: Message Age 1 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%
```

Bridge 3

```
#show spanning-tree
% 3: Bridge up - Spanning Tree Enabled  - topology change detected
% 3: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 3: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 3: Root Id 80005254000835af
% 3: Bridge Id 80005254000835af
% 3: last topology change Mon Mar  4 11:39:11 2019
% 3: 2 topology change(s)  - last topology change Mon Mar  4 11:39:11 2019

% 3: portfast bpdu-filter disabled
% 3: portfast bpdu-guard disabled
% 3: portfast errdisable timeout disabled
% 3: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 80005254000835af
%   eth1: Designated Bridge 80005254000835af
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 80005254000835af
%   eth2: Designated Bridge 80005254000835af
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth2: forward-transitions 1
%   eth2: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
```

Bridge 4

```
#show spanning-tree
% 4: Bridge up - Spanning Tree Enabled  - topology change detected
% 4: Root Path Cost 40000 - Root Port 3 -  Bridge Priority 32768
% 4: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 4: Root Id 8000525400244323
% 4: Bridge Id 8000525400b83253
% 4: last topology change Mon Mar  4 11:40:40 2019
% 4: 3 topology change(s)  - last topology change Mon Mar  4 11:40:40 2019

% 4: portfast bpdu-filter disabled
% 4: portfast bpdu-guard disabled
% 4: portfast errdisable timeout disabled
% 4: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated Path Cost 20000
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8005 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400d15789
%   eth1: Message Age 1 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
%   eth2: Designated Path Cost 20000
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8006 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400d15789
%   eth2: Message Age 1 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change
timer 0
%   eth2: forward-transitions 0
%   eth2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 40000
```

```
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400b83253
%   eth3: Message Age 2 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 40000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400b83253
%   eth4: Message Age 2 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%
#
```

CHAPTER 4 RSTP Configuration

This chapter contains a complete sample Rapid Spanning Tree Protocol (RSTP) configuration. RSTP provides rapid convergence of a spanning tree. It speeds up the reconfiguration of the tree after a change by using alternate ports.

Topology

The following example is a simple multi-bridge topology.

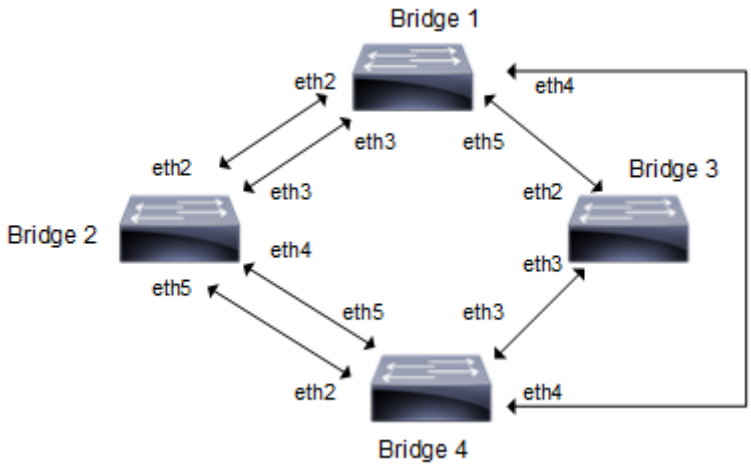


Figure 4-4: RSTP Topology

Note: Run the `switchport` command on each port to change to Layer-2 mode.

Configuration

Bridge 1

`Bridge1#configure terminal`	Enter configure mode.
`Bridge1(config)#bridge 1 protocol rstp`	Add a bridge (`1`) to the rapid spanning tree table
`Bridge1(config)#interface eth2`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group 1.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth3`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth4`	Enter interface mode.
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth5`	Enter interface mode
`Bridge1(config-if)#bridge-group 1`	Associate the interface with bridge group `1`.

Bridge 2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#bridge 2 protocol rstp`	Add a bridge (`2`) to the rapid spanning tree table
`Bridge2(config)#interface eth2`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth3`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth4`	Enter interface mode.
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth5`	Enter interface mode
`Bridge2(config-if)#bridge-group 2`	Associate the interface with bridge group `2`.

Bridge 3

`Bridge3#configure terminal`	Enter configure mode.
`Bridge3(config)#bridge 3 protocol rstp`	Add a bridge `(3)` to the rapid spanning tree table
`Bridge3(config)#interface eth2`	Enter interface mode.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group `3`.
`Bridge3(config-if)#exit`	Exit interface mode.
`Bridge3(config)#interface eth3`	Enter interface mode.
`Bridge3(config-if)#bridge-group 3`	Associate the interface with bridge group `3`.

Bridge 4

`Bridge4#configure terminal`	Enter configure mode.
`Bridge4(config)#bridge 4 protocol rstp`	Add a bridge `(4)` to the rapid spanning tree table
`Bridge4(config)#interface eth2`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth3`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth4`	Enter interface mode.
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth5`	Enter interface mode
`Bridge4(config-if)#bridge-group 4`	Associate the interface with bridge group `4`.

Validation

show spanning-tree, show spanning-tree interface <if-name>

Bridge 1

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8000525400244323
% 1: Bridge Id 8000525400244323
% 1: last topology change Mon Mar  4 11:40:41 2019
% 1: 20 topology change(s)  - last topology change Mon Mar  4 11:40:41 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400244323
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth2: forward-transitions 1
%   eth2: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
```

```
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 0
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400244323
%   eth3: Message Age 0 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 0
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400244323
%   eth4: Message Age 0 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%
#

#show spanning-tree interface eth1
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8000525400244323
% 1: Bridge Id 8000525400244323
% 1: last topology change Mon Mar  4 11:40:41 2019
% 1: 20 topology change(s)  - last topology change Mon Mar  4 11:40:41 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
```

```
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%
#
```

Bridge 2

```
#show spanning-tree
% 2: Bridge up - Spanning Tree Enabled  - topology change detected
% 2: Root Path Cost 20000 - Root Port 3 -  Bridge Priority 32768
% 2: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 2: Root Id 8000525400244323
% 2: Bridge Id 8000525400d15789
% 2: last topology change Mon Mar  4 11:40:43 2019
% 2: 11 topology change(s)  - last topology change Mon Mar  4 11:40:43 2019

% 2: portfast bpdu-filter disabled
% 2: portfast bpdu-guard disabled
% 2: portfast errdisable timeout disabled
% 2: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400244323
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
```

```
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400244323
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 1 - topo change
timer 0
%   eth2: forward-transitions 0
%   eth2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 20000
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400d15789
%   eth3: Message Age 1 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 20000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400d15789
%   eth4: Message Age 1 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
```

```
%   eth4: No auto-edge configured - Current port Auto Edge off
%
#
```

Bridge 3

```
#show spanning-tree
% 3: Bridge up - Spanning Tree Enabled  - topology change detected
% 3: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 3: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 3: Root Id 80005254000835af
% 3: Bridge Id 80005254000835af
% 3: last topology change Mon Mar  4 11:39:11 2019
% 3: 2 topology change(s)  - last topology change Mon Mar  4 11:39:11 2019

% 3: portfast bpdu-filter disabled
% 3: portfast bpdu-guard disabled
% 3: portfast errdisable timeout disabled
% 3: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Path Cost 0
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 80005254000835af
%   eth1: Designated Bridge 80005254000835af
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Path Cost 0
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8004 - Priority 128  -
%   eth2: Root 80005254000835af
%   eth2: Designated Bridge 80005254000835af
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth2: forward-transitions 1
%   eth2: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
```

```
%
#
```

Bridge 4

```
#show spanning-tree
% 4: Bridge up - Spanning Tree Enabled  - topology change detected
% 4: Root Path Cost 40000 - Root Port 3 -  Bridge Priority 32768
% 4: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 4: Root Id 8000525400244323
% 4: Bridge Id 8000525400b83253
% 4: last topology change Mon Mar  4 11:40:40 2019
% 4: 3 topology change(s)  - last topology change Mon Mar  4 11:40:40 2019

% 4: portfast bpdu-filter disabled
% 4: portfast bpdu-guard disabled
% 4: portfast errdisable timeout disabled
% 4: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated Path Cost 20000
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth1: Designated Port Id 0x8005 - Priority 128  -
%   eth1: Root 8000525400244323
%   eth1: Designated Bridge 8000525400d15789
%   eth1: Message Age 1 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
%   eth2: Designated Path Cost 20000
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth2: Designated Port Id 0x8006 - Priority 128  -
%   eth2: Root 8000525400244323
%   eth2: Designated Bridge 8000525400d15789
%   eth2: Message Age 1 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change
timer 0
%   eth2: forward-transitions 0
%   eth2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
```

```
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Path Cost 40000
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth3: Designated Port Id 0x8005 - Priority 128  -
%   eth3: Root 8000525400244323
%   eth3: Designated Bridge 8000525400b83253
%   eth3: Message Age 2 - Max Age 20
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 1
%   eth3: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Path Cost 40000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 1
%   eth4: Designated Port Id 0x8006 - Priority 128  -
%   eth4: Root 8000525400244323
%   eth4: Designated Bridge 8000525400b83253
%   eth4: Message Age 2 - Max Age 20
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 1
%   eth4: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%
#
```

CHAPTER 5 MSTP Configuration

This chapter contains a complete sample Multiple Spanning Tree Protocol (MSTP) configuration. MSTP allows multiple VLANs to be grouped into one spanning-tree instance. Every MST instance has a spanning-tree that is independent of other spanning-tree instances providing multiple forwarding paths for data traffic.

Topology

This example gives a simple multi-bridge topology and its configuration.

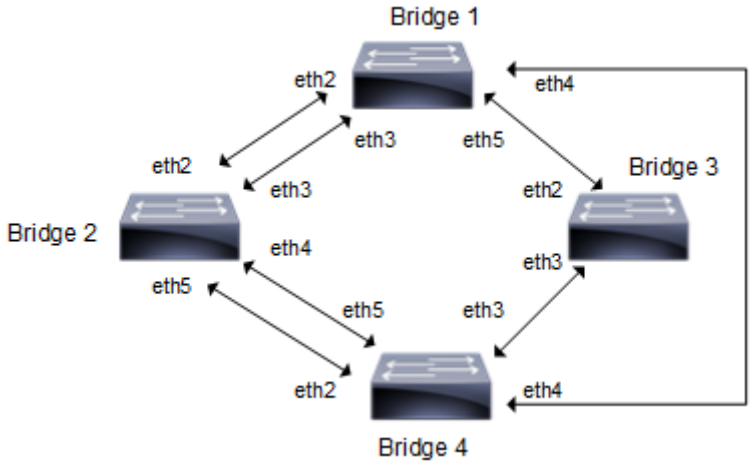


Figure 5-5: MSTP Topology

Note: Run the `switchport` command on each port to change to Layer-2 mode.

Configuration

Bridge 1

`Bridge1#configure terminal`	Enter configure mode.
`Bridge1(config)#bridge 1 protocol mstp`	Add a bridge (1) to the multiple spanning tree table.
`Bridge1(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge1(config-vlan)#vlan 2 bridge 1 state enable`	Enable the state of VLAN 2 on bridge 1. Specifying an enable state allows forwarding of frames over VLAN 2 on bridge 1.
`Bridge1(config-vlan)#vlan 3 bridge 1 state enable`	Enable the state of VLAN 3 on bridge 1. Specifying an enable state allows forwarding of frames over VLAN 3 on bridge 1.
`Bridge1(config-vlan)#vlan 4 bridge 1 state enable`	Enable the state of VLAN 4 on bridge 1. Specifying an enable state allows forwarding of frames over VLAN 4 on bridge 1.
`Bridge1(config-vlan)#vlan 5 bridge 1 state enable`	Enable the state of VLAN 5 on bridge 1. Specifying an enable state allows forwarding of frames over VLAN 5 on bridge 1.
`Bridge1(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge1(config)#spanning-tree mst configuration`	Enter the Multiple Spanning Tree

`Bridge1(config-mst)#bridge 1 instance 2 vlan 2`	Create an instance of VLAN. The VLANs must be created before being associating with an MST instance (MSTI). If the VLAN range is not specified the MSTI will not be created.
`Bridge1(config-mst)#bridge 1 instance 3 vlan 3`	Create another instance of VLAN. The VLANs must be created before being associating with an MST instance (MSTI). If the VLAN range is not specified the MSTI will not be created.
`Bridge1(config-mst)#bridge 1 instance 4 vlan 4`	same as mention above.
`Bridge1(config-mst)#bridge 1 instance 5 vlan 5`	same as mention above.
`Bridge1(config-mst)#exit`	Exit MST Configuration mode.
`Bridge1(config)#interface eth2`	Enter interface mode for eth2
`Bridge1(config-if)#bridge-group 1`	Associating the interface to bridge-group 1
`Bridge1(config-if)#bridge-group 1 instance 2`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 3`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 4`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 5`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth3`	Enter interface mode for eth3.
`Bridge1(config-if)#bridge-group 1`	Associating the interface to bridge-group 1
`Bridge1(config-if)#bridge-group 1 instance 2`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 3`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 4`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 5`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth4`	Enter interface mode for eth4.
`Bridge1(config-if)#bridge-group 1`	Associating the interface to bridge-group 1
`Bridge1(config-if)#bridge-group 1 instance 2`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 3`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 4`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 5`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#exit`	Exit interface mode.
`Bridge1(config)#interface eth5`	Enter interface mode for eth5.
`Bridge1(config-if)#bridge-group 1`	Associating the interface to bridge-group 1

`Bridge1(config-if)#bridge-group 1 instance 2`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 3`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 4`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#bridge-group 1 instance 5`	Assigning bridge-group 1 to this instance
`Bridge1(config-if)#exit`	Exit interface mode.

Bridge 2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#bridge 2 protocol mstp`	Add a bridge (2) to the multiple spanning
`Bridge2(config)#bridge 2 priority 4096`	Assign priority to this bridge.
`Bridge2(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge2(config-vlan)#vlan 2 bridge 2 state enable`	Enable the state of VLAN 2 on bridge 2. Specifying an enable state allows forwarding of frames over VLAN 2 on bridge 2.
`Bridge2(config-vlan)#vlan 3 bridge 2 state enable`	Enable the state of VLAN 3 on bridge 2. Specifying an enable state allows forwarding of frames over VLAN 3 on bridge 2
`Bridge2(config-vlan)#vlan 4 bridge 2 state enable`	Enable the state of VLAN 4 on bridge 2. Specifying an enable state allows forwarding of frames over VLAN 4 on bridge 2
`Bridge2(config-vlan)#vlan 5 bridge 2 state enable`	Enable the state of VLAN 5 on bridge 2. Specifying an enable state allows forwarding of frames over VLAN 5 on bridge 2
`Bridge2(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge2(config)#spanning-tree mst configuration`	Enter the Multiple Spanning Tree configuration mode
`Bridge2(config-mst)#bridge 2 instance 2 vlan 2`	Create an instance of VLAN. The VLANs must be created before being associating with an MST instance (MSTI). If the VLAN range is not specified the MSTI will not be created.
`Bridge2(config-mst)#bridge 2 instance 3 vlan 3`	same as mention above.
`Bridge2(config-mst)#bridge 2 instance 4 vlan 4`	same as mention above.
`Bridge2(config-mst)#bridge 2 instance 5 vlan 5`	same as mention above.
`Bridge2(config-mst)#exit`	Exit MST Configuration mode.
`Bridge2(config)#interface eth2`	Enter interface mode for eth2
`Bridge2(config-if)#bridge-group 2`	Associating the interface to bridge-group 2
`Bridge2(config-if)#bridge-group 2 instance 2`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 3`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 4`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 5`	Assigning bridge-group 2 to this instance

`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth3`	Enter interface mode for eth3
`Bridge2(config-if)#bridge-group 2`	Associating the interface to bridge-group 2
`Bridge2(config-if)#bridge-group 2 instance 2`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 3`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 3 priority 16`	Assign bridge-group 2 to this instance and set a port priority in order of 16 for it. MSTP uses port priority as a tiebreaker to determine which port should forward frames for a particular instance on a LAN, or which port should be the root port for an instance. A lower value implies better priority.
`Bridge2(config-if)#bridge-group 2 instance 4`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 4 priority 16`	Assign bridge-group 2 to this instance and set a port priority in order of 16 for it. MSTP uses port priority as a tiebreaker to determine which port should forward frames for a particular instance on a LAN, or which port should be the root port for an instance. A lower value implies better priority
`Bridge2(config-if)#bridge-group 2 instance 5`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#exit`	Exit interface mode
`Bridge2(config)#interface eth4`	Enter interface mode for eth4
`Bridge2(config-if)#bridge-group 2`	Associating the interface to bridge-group 2
`Bridge2(config-if)#bridge-group 2 instance 2`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 3`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 4`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 5`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#exit`	Exit interface mode.
`Bridge2(config)#interface eth5`	Enter interface mode for eth5
`Bridge2(config-if)#bridge-group 2`	Associating the interface to bridge-group 2
`Bridge2(config-if)#bridge-group 2 instance 2`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 3`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 4`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#bridge-group 2 instance 5`	Assigning bridge-group 2 to this instance
`Bridge2(config-if)#exit`	Exit interface mode.

Bridge 3

`Bridge3#configure terminal`	Enter configure mode.
`Bridge3(config)#bridge 3 protocol mstp`	Add a bridge (3) to the multiple spanning tree table
`Bridge3(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge3(config-vlan)#vlan 2 bridge 3 state enable`	Enable the state of VLAN 2 on bridge 3. Specifying an enable state allows forwarding of frames over VLAN 2 on bridge 3.
`Bridge3(config-vlan)#vlan 3 bridge 3 state enable`	Enable the state of VLAN 3 on bridge 3. Specifying an enable state allows forwarding of frames over VLAN 3 on bridge 3.
`Bridge3(config-vlan)#vlan 4 bridge 3 state enable`	Enable the state of VLAN 4 on bridge 3. Specifying an enable state allows forwarding of frames over VLAN 4 on bridge 3.
`Bridge3(config-vlan)#vlan 5 bridge 3 state enable`	Enable the state of VLAN 5 on bridge 3. Specifying an enable state allows forwarding of frames over VLAN 5 on bridge 3.
`Bridge3(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge3(config)#spanning-tree mst configuration`	Enter the Multiple Spanning Tree Configuration mode.
`Bridge3(config-mst)#bridge 3 instance 2 vlan 2`	Create an instance of VLAN. The VLANs must be created before being associating with an MST instance (MSTI). If the VLAN range is not specified the MSTI will not be created.
`Bridge3(config-mst)#bridge 3 instance 3 vlan 3`	same as mention above.
`Bridge3(config-mst)#bridge 3 instance 4 vlan 4`	same as mention above.
`Bridge3(config-mst)#bridge 3 instance 5 vlan 5`	same as mention above.
`Bridge3(config-mst)#exit`	Exit MST Configuration mode.
`Bridge3(config)#interface eth2`	Enter interface mode for eth2
`Bridge3(config-if)#bridge-group 3`	Associating the interface to bridge-group 3
`Bridge3(config-if)#bridge-group 3 instance 2`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 3`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 4`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 5`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#exit`	Exit interface mode.
`Bridge3(config)#interface eth3`	Enter interface mode for eth3
`Bridge3(config-if)#bridge-group 3`	Associating the interface to bridge-group 3

`Bridge3(config-if)#bridge-group 3 instance 2`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 3`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 4`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#bridge-group 3 instance 5`	Assigning bridge-group 3 to this instance
`Bridge3(config-if)#exit`	Exit interface mode.

Bridge 4

`Bridge4#configure terminal`	Enter configure mode.
`Bridge4(config)#bridge 4 protocol mstp`	Add a bridge (4) to the multiple spanning tree table
`Bridge4(config)#vlan database`	Enter the VLAN configuration mode.
`Bridge4(config-vlan)#vlan 2 bridge 4 state enable`	Enable the state of VLAN 2 on bridge 4. Specifying an enable state allows forwarding of frames over VLAN 2 on bridge 4.
`Bridge4(config-vlan)#vlan 3 bridge 4 state enable`	Enable the state of VLAN 3 on bridge 4. Specifying an enable state allows forwarding of frames over VLAN 3 on bridge 4.
`Bridge4(config-vlan)#vlan 4 bridge 4 state enable`	Enable the state of VLAN 4 on bridge 4. Specifying an enable state allows forwarding of frames over VLAN 4 on bridge 4.
`Bridge4(config-vlan)#vlan 5 bridge 4 state enable`	Enable the state of VLAN 5 on bridge 4. Specifying an enable state allows forwarding of frames over VLAN 5 on bridge 4.
`Bridge4(config-vlan)#exit`	Exit the VLAN configuration mode.
`Bridge4(config)#spanning-tree mst configuration`	Enter the Multiple Spanning Tree Configuration mode.
`Bridge4(config-mst)#bridge 4 instance 2 vlan 2`	Create an instance of VLAN. The VLANs must be created before being associating with an MST instance (MSTI). If the VLAN range is not specified the MSTI will not be created.
`Bridge4(config-mst)#bridge 4 instance 3 vlan 3`	same as mention above.
`Bridge4(config-mst)#bridge 4 instance 4 vlan 4`	same as mention above.
`Bridge4(config-mst)#bridge 4 instance 5 vlan 5`	same as mention above.
`Bridge4(config-mst)#exit`	Exit MST Configuration mode.
`Bridge4(config)#interface eth2`	Enter interface mode for eth2
`Bridge4(config-if)#bridge-group  4`	Associating the interface to bridge-group 4
`Bridge4(config-if)#bridge-group 4 instance 2`	Assigning bridge-group 4 to this instance
`Bridge4(config-if)#bridge-group 4 instance 3`	Assigning bridge-group 4 to this instance
`Bridge4(config-if)#bridge-group 4 instance 4`	Assigning bridge-group 4 to this instance
`Bridge4(config-if)#bridge-group 4 instance 5`	Assigning bridge-group 4 to this instance
`Bridge4(config-if)#exit`	Exit interface mode.
`Bridge4(config)#interface eth3`	Enter interface mode for eth3

Bridge4(config-if)#bridge-group 4	Associating the interface to bridge-group 4
Bridge4(config-if)#bridge-group 4 instance 2	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 3	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 4	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 5	Assigning bridge-group 4 to this instance
Bridge4(config-if)#exit	Exit interface mode.
Bridge4(config)#interface eth4	Enter interface mode for eth4
Bridge4(config-if)#bridge-group 4	Associating the interface to bridge-group 4
Bridge4(config-if)#bridge-group 4 instance 2	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 3	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 4	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 5	Assigning bridge-group 4 to this instance
Bridge4(config-if)#exit	Exit interface mode.
Bridge4(config)#interface eth5	Enter interface mode for eth5
Bridge4(config-if)#bridge-group 4	Associating the interface to bridge-group 4
Bridge4(config-if)#bridge-group 4 instance 2	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 3	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 4	Assigning bridge-group 4 to this instance
Bridge4(config-if)#bridge-group 4 instance 5	Assigning bridge-group 4 to this instance
Bridge4(config-if)#exit	Exit interface mode.

Validation

show spanning-tree, show spanning-tree mst detail

```
#show spanning-tree mst detail
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: CIST Root Path Cost 0 - CIST Root Port 3 -  CIST Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Max-hops 20
% 1: CIST Root Id 1000525400d15789
% 1: CIST Reg Root Id 1000525400d15789
% 1: CIST Bridge Id 8000525400244323
% 1: 26 topology change(s)  - last topology change Mon Mar  4 12:58:35 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
```

```
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth1: Designated Port Id 0x8003 - CIST Priority 128  -
%   eth1: CIST Root 1000525400d15789
%   eth1: Regional Root 1000525400d15789
%   eth1: Designated Bridge 1000525400d15789
%   eth1: Message Age 0 - Max Age 20
%   eth1: CIST Hello Time 2 - Forward Delay 15
%   eth1: CIST Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
%   eth2: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth2: Designated Port Id 0x8004 - CIST Priority 128  -
%   eth2: CIST Root 1000525400d15789
%   eth2: Regional Root 1000525400d15789
%   eth2: Designated Bridge 1000525400d15789
%   eth2: Message Age 0 - Max Age 20
%   eth2: CIST Hello Time 2 - Forward Delay 15
%   eth2: CIST Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change
timer 0
%   eth2: forward-transitions 2
%   eth2: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth3: Designated Port Id 0x8005 - CIST Priority 128  -
%   eth3: CIST Root 1000525400d15789
%   eth3: Regional Root 1000525400d15789
%   eth3: Designated Bridge 8000525400244323
%   eth3: Message Age 0 - Max Age 20
%   eth3: CIST Hello Time 2 - Forward Delay 15
%   eth3: CIST Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 3
%   eth3: Version Multiple Spanning Tree Protocol - Received None - Send MSTP
%   eth3: No portfast configured - Current  portfast off
```

```
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth4: Designated Port Id 0x8006 - CIST Priority 128  -
%   eth4: CIST Root 1000525400d15789
%   eth4: Regional Root 1000525400d15789
%   eth4: Designated Bridge 8000525400244323
%   eth4: Message Age 0 - Max Age 20
%   eth4: CIST Hello Time 2 - Forward Delay 15
%   eth4: CIST Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth4: forward-transitions 3
%   eth4: Version Multiple Spanning Tree Protocol - Received None - Send MSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off
%

% Instance  2:  Vlans: 2

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 8002525400244323
% 1: MSTI Bridge Id 8002525400244323
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 20000
%   eth1: Configured CST External Path cost 20000
%   eth1: CST Priority 128  - MSTI Priority 128
%   eth1: Designated Root 8002525400244323
%   eth1: Designated Bridge 8002525400244323
%   eth1: Message Age 0
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0

%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 20000
%   eth2: Configured CST External Path cost 20000
%   eth2: CST Priority 128  - MSTI Priority 128
%   eth2: Designated Root 8002525400244323
%   eth2: Designated Bridge 8002525400244323
%   eth2: Message Age 0
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1
```

```
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Internal Path Cost 0  - Designated Port Id 0x8005
%   eth3: Configured Internal Path Cost 20000
%   eth3: Configured CST External Path cost 20000
%   eth3: CST Priority 128  - MSTI Priority 128
%   eth3: Designated Root 8002525400244323
%   eth3: Designated Bridge 8002525400244323
%   eth3: Message Age 0
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Internal Path Cost 0  - Designated Port Id 0x8006
%   eth4: Configured Internal Path Cost 20000
%   eth4: Configured CST External Path cost 20000
%   eth4: CST Priority 128  - MSTI Priority 128
%   eth4: Designated Root 8002525400244323
%   eth4: Designated Bridge 8002525400244323
%   eth4: Message Age 0
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1


% Instance  3:  Vlans: 3

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 8003525400244323
% 1: MSTI Bridge Id 8003525400244323
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Masterport - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 20000
%   eth1: Configured CST External Path cost 20000
%   eth1: CST Priority 128  - MSTI Priority 128
%   eth1: Designated Root 8003525400244323
%   eth1: Designated Bridge 8003525400244323
%   eth1: Message Age 0
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0

%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 20000
%   eth2: Configured CST External Path cost 20000
%   eth2: CST Priority 128  - MSTI Priority 128
%   eth2: Designated Root 8003525400244323
%   eth2: Designated Bridge 8003525400244323
%   eth2: Message Age 0
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Internal Path Cost 0  - Designated Port Id 0x8005
%   eth3: Configured Internal Path Cost 20000
```



```
%   eth3: Configured CST External Path cost 20000
%   eth3: CST Priority 128  - MSTI Priority 128
%   eth3: Designated Root 8003525400244323
%   eth3: Designated Bridge 8003525400244323
%   eth3: Message Age 0
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Internal Path Cost 0  - Designated Port Id 0x8006
%   eth4: Configured Internal Path Cost 20000
%   eth4: Configured CST External Path cost 20000
%   eth4: CST Priority 128  - MSTI Priority 128
%   eth4: Designated Root 8003525400244323
%   eth4: Designated Bridge 8003525400244323
%   eth4: Message Age 0
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1


% Instance  4:  Vlans: 4

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 8004525400244323
% 1: MSTI Bridge Id 8004525400244323
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Masterport - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 20000
%   eth1: Configured CST External Path cost 20000
%   eth1: CST Priority 128  - MSTI Priority 128
%   eth1: Designated Root 8004525400244323
%   eth1: Designated Bridge 8004525400244323
%   eth1: Message Age 0
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0

%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 20000
%   eth2: Configured CST External Path cost 20000
%   eth2: CST Priority 128  - MSTI Priority 128
%   eth2: Designated Root 8004525400244323
%   eth2: Designated Bridge 8004525400244323
%   eth2: Message Age 0
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Internal Path Cost 0  - Designated Port Id 0x8005
%   eth3: Configured Internal Path Cost 20000
%   eth3: Configured CST External Path cost 20000
%   eth3: CST Priority 128  - MSTI Priority 128
%   eth3: Designated Root 8004525400244323
```

```
%   eth3: Designated Bridge 8004525400244323
%   eth3: Message Age 0
%   eth3: Hello Time 2 - Forward Delay 15
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Internal Path Cost 0  - Designated Port Id 0x8006
%   eth4: Configured Internal Path Cost 20000
%   eth4: Configured CST External Path cost 20000
%   eth4: CST Priority 128  - MSTI Priority 128
%   eth4: Designated Root 8004525400244323
%   eth4: Designated Bridge 8004525400244323
%   eth4: Message Age 0
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1


% Instance  5:  Vlans: 5

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 8005525400244323
% 1: MSTI Bridge Id 8005525400244323
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Masterport - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 20000
%   eth1: Configured CST External Path cost 20000
%   eth1: CST Priority 128  - MSTI Priority 128
%   eth1: Designated Root 8005525400244323
%   eth1: Designated Bridge 8005525400244323
%   eth1: Message Age 0
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0

%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 20000
%   eth2: Configured CST External Path cost 20000
%   eth2: CST Priority 128  - MSTI Priority 128
%   eth2: Designated Root 8005525400244323
%   eth2: Designated Bridge 8005525400244323
%   eth2: Message Age 0
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated Internal Path Cost 0  - Designated Port Id 0x8005
%   eth3: Configured Internal Path Cost 20000
%   eth3: Configured CST External Path cost 20000
%   eth3: CST Priority 128  - MSTI Priority 128
%   eth3: Designated Root 8005525400244323
%   eth3: Designated Bridge 8005525400244323
%   eth3: Message Age 0
%   eth3: Hello Time 2 - Forward Delay 15
```



```
%   eth3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated Internal Path Cost 0  - Designated Port Id 0x8006
%   eth4: Configured Internal Path Cost 20000
%   eth4: Configured CST External Path cost 20000
%   eth4: CST Priority 128  - MSTI Priority 128
%   eth4: Designated Root 8005525400244323
%   eth4: Designated Bridge 8005525400244323
%   eth4: Message Age 0
%   eth4: Hello Time 2 - Forward Delay 15
%   eth4: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1


#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: CIST Root Path Cost 0 - CIST Root Port 3 -  CIST Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Max-hops 20
% 1: CIST Root Id 1000525400d15789
% 1: CIST Reg Root Id 1000525400d15789
% 1: CIST Bridge Id 8000525400244323
% 1: 26 topology change(s)  - last topology change Mon Mar  4 12:58:35 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Rootport - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth1: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth1: Designated Port Id 0x8003 - CIST Priority 128  -
%   eth1: CIST Root 1000525400d15789
%   eth1: Regional Root 1000525400d15789
%   eth1: Designated Bridge 1000525400d15789
%   eth1: Message Age 0 - Max Age 20
%   eth1: CIST Hello Time 2 - Forward Delay 15
%   eth1: CIST Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change
timer 0
%   eth1: forward-transitions 1
%   eth1: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Alternate - State
Discarding
%   eth2: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth2: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth2: Designated Port Id 0x8004 - CIST Priority 128  -
%   eth2: CIST Root 1000525400d15789
%   eth2: Regional Root 1000525400d15789
%   eth2: Designated Bridge 1000525400d15789
```

```
%   eth2: Message Age 0 - Max Age 20
%   eth2: CIST Hello Time 2 - Forward Delay 15
%   eth2: CIST Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change
timer 0
%   eth2: forward-transitions 2
%   eth2: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%
%   eth3: Port Number 5 - Ifindex 5 - Port Id 0x8005 - Role Designated - State
Forwarding
%   eth3: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth3: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth3: Designated Port Id 0x8005 - CIST Priority 128  -
%   eth3: CIST Root 1000525400d15789
%   eth3: Regional Root 1000525400d15789
%   eth3: Designated Bridge 8000525400244323
%   eth3: Message Age 0 - Max Age 20
%   eth3: CIST Hello Time 2 - Forward Delay 15
%   eth3: CIST Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change
timer 0
%   eth3: forward-transitions 3
%   eth3: Version Multiple Spanning Tree Protocol - Received None - Send MSTP
%   eth3: No portfast configured - Current  portfast off
%   eth3: bpdu-guard  default  - Current bpdu-guard off
%   eth3: bpdu-filter default  - Current bpdu-filter off
%   eth3: no root guard configured     - Current root guard off
%   eth3: Configured Link Type point-to-point - Current point-to-point
%   eth3: No auto-edge configured - Current port Auto Edge off
%
%   eth4: Port Number 6 - Ifindex 6 - Port Id 0x8006 - Role Designated - State
Forwarding
%   eth4: Designated External Path Cost 0 -Internal Path Cost 20000
%   eth4: Configured Path Cost 20000  - Add type Explicit ref count 5
%   eth4: Designated Port Id 0x8006 - CIST Priority 128  -
%   eth4: CIST Root 1000525400d15789
%   eth4: Regional Root 1000525400d15789
%   eth4: Designated Bridge 8000525400244323
%   eth4: Message Age 0 - Max Age 20
%   eth4: CIST Hello Time 2 - Forward Delay 15
%   eth4: CIST Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change
timer 0
%   eth4: forward-transitions 3
%   eth4: Version Multiple Spanning Tree Protocol - Received None - Send MSTP
%   eth4: No portfast configured - Current  portfast off
%   eth4: bpdu-guard  default  - Current bpdu-guard off
%   eth4: bpdu-filter default  - Current bpdu-filter off
%   eth4: no root guard configured     - Current root guard off
%   eth4: Configured Link Type point-to-point - Current point-to-point
%   eth4: No auto-edge configured - Current port Auto Edge off%
#
```

CHAPTER 6 Disable Spanning Tree Configuration

This chapter describes disabling spanning tree operation on a per Multiple Spanning Tree Instance (MSTI) basis.

Topology

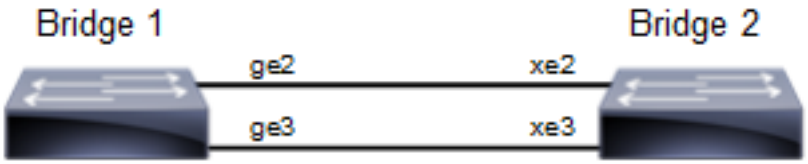


Figure 6-6: Disable Spanning Tree Topology

Note: Run the `switchport` command on each port to change to Layer-2 mode.

Disabling MSTP Configuration

Bridge 1

Disabling MSTP per instance

`Bridge1(config-mst)#no bridge 1 instance 2`	Disable spanning tree for MSTP on instance 2
`Bridge1(config-mst)#no bridge 1 instance 3`	Disable spanning tree for MSTP on instance 3

Disabling MSTP globally

`Bridge1(config)#no bridge 1 multiple-spanning-tree enable bridge-forward`	Disable spanning tree globally for MSTP and keeping the ports in forwarding state.

Disabling MSTP per port

`Bridge1(config)#interface ge2`	Enter interface mode for ge2.
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for MSTP and put port on forwarding state. This command disables any type of STP on the port.

Bridge 2

Disabling MSTP per instance

`Bridge2(config-mst)#no bridge 1 instance 2`	Disable spanning tree for MSTP on instance 2
`Bridge2(config-mst)#no bridge 1 instance 3`	Disable spanning tree for MSTP on instance 3

Disabling MSTP globally

`Bridge2(config)#no bridge 1 multiple-spanning-tree enable bridge-forward`	Disable spanning tree globally for MSTP.

Disabling MSTP per port

`Bridge2(config)#interface xe2`	Enter interface mode for xe2.
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for MSTP and put port on forwarding state. This command disables any type of STP on the port.

Validation

Bridge 1

Verify MSTP details with the `show spanning-tree mst detail` command.

```
#show spanning-tree mst detail
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: CIST Root Path Cost 0 - CIST Root Port 905 -  CIST Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Max-hops 20
% 1: CIST Root Id 80003417ebfbe9c4
% 1: CIST Reg Root Id 80003417ebfbe9c4
% 1: CIST Bridge Id 800064006ac779a0
% 1: 9 topology change(s)  - last topology change Thu Nov 17 15:06:17 2016
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Rootport -
State Forwarding
%   ge2: Designated External Path Cost 0 -Internal Path Cost 20000
%   ge2: Configured Path Cost 20000  - Add type Explicit ref count 2
%   ge2: Designated Port Id 0x838a - CIST Priority 128  -
%   ge2: CIST Root 80003417ebfbe9c4
%   ge2: Regional Root 80003417ebfbe9c4
%   ge2: Designated Bridge 80003417ebfbe9c4
%   ge2: Message Age 0 - Max Age 20
%   ge2: CIST Hello Time 2 - Forward Delay 15
%   ge2: CIST Forward Timer 0 - Msg Age Timer 4 - Hello Timer 0 - topo change
timer 0
%   ge2: forward-transitions 1
%   ge2: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   ge2: No portfast configured - Current  portfast off
%   ge2: bpdu-guard  default  - Current bpdu-guard off
%   ge2: bpdu-filter default  - Current bpdu-filter off
%   ge2: no root guard configured     - Current root guard off
%   ge2: Configured Link Type point-to-point - Current point-to-point
%   ge2: No auto-edge configured - Current port Auto Edge off
%
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Alternate -
State Discarding
%   ge3: Designated External Path Cost 0 -Internal Path Cost 20000
```

```
%   ge3: Configured Path Cost 20000  - Add type Explicit ref count 2
%   ge3: Designated Port Id 0x838b - CIST Priority 128  -
%   ge3: CIST Root 80003417ebfbe9c4
%   ge3: Regional Root 80003417ebfbe9c4
%   ge3: Designated Bridge 80003417ebfbe9c4
%   ge3: Message Age 0 - Max Age 20
%   ge3: CIST Hello Time 2 - Forward Delay 15
%   ge3: CIST Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change
timer 0
%   ge3: forward-transitions 2
%   ge3: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   ge3: No portfast configured - Current  portfast off
%   ge3: bpdu-guard  default  - Current bpdu-guard off
%   ge3: bpdu-filter default  - Current bpdu-filter off
%   ge3: no root guard configured     - Current root guard off
%   ge3: Configured Link Type point-to-point - Current point-to-point
%   ge3: No auto-edge configured - Current port Auto Edge off

% Instance  2:  Vlans: 2

% 1: MSTI Root Path Cost 20000 -MSTI Root Port 5001 - MSTI Bridge Priority
32768
% 1: MSTI Root Id 80023417ebfbe9c4
% 1: MSTI Bridge Id 800264006ac779a0
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Rootport -
State Forwarding
%   ge2: Designated Internal Path Cost 0  - Designated Port Id 0x838a
%   ge2: Configured Internal Path Cost 20000
%   ge2: Configured CST External Path cost 20000
%   ge2: CST Priority 128  - MSTI Priority 128
%   ge2: Designated Root 80023417ebfbe9c4
%   ge2: Designated Bridge 800264006ac779a0
%   ge2: Message Age 0
%   ge2: Hello Time 2 - Forward Delay 15
%   ge2: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 0

% Instance  3:  Vlans: 3

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 800364006ac779a0
% 1: MSTI Bridge Id 800364006ac779a0
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Designated -
State Forwarding
%   ge3: Designated Internal Path Cost 0  - Designated Port Id 0x838c
%   ge3: Configured Internal Path Cost 20000
%   ge3: Configured CST External Path cost 20000
%   ge3: CST Priority 128  - MSTI Priority 128
%   ge3: Designated Root 800364006ac779a0
%   ge3: Designated Bridge 800364006ac779a0
%   ge3: Message Age 0
%   ge3: Hello Time 2 - Forward Delay 15
%   ge3: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1
```

Verify MSTP configurations when MSTP is enabled globally.

```
#show running-config
!
bridge 1 protocol mstp
!
```

Verify MSTP configurations when MSTP is disabled globally.

```
#show running-config
!
bridge 1 protocol mstp
no bridge 1 multiple-spanning-tree enable bridge-forward
!
```

Verify MSTP configurations when MSTP instance 2 and 3 is enabled.

```
#show running-config spanning-tree
!
spanning-tree mst configuration
bridge 1  instance 2
bridge 1  instance 2 vlan 2
bridge 1  instance 3
bridge 1  instance 3 vlan 3
!
interface xe2
bridge-group 1 instance 2
!
interface xe3
bridge-group 1 instance 3
!
```

- Verify MSTP configurations when MSTP instance 2 is disabled

```
#show running-config spanning-tree
!
spanning-tree mst configuration
bridge 1 instance 3
bridge 1 instance 3 vlan 3
!
interface ge3
bridge-group 1 instance 3
!
```

Verify MSTP configurations when spanning-tree is enabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1
switchport mode access
switchport access vlan 2
bridge-group 1 instance 2
!
```

Verify MSTP configurations when spanning-tree is disabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1 spanning-tree disable
switchport mode access
switchport access vlan 2
bridge-group 1 instance 2
```

Verify MSTP details after disabling spanning-tree on interface ge2 with the `show spanning-tree mst details` command.


```
#show spanning-tree mst detail
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: CIST Root Path Cost 0 - CIST Root Port 908 -  CIST Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Max-hops 20
% 1: CIST Root Id 80003417ebfbe9c4
% 1: CIST Reg Root Id 80003417ebfbe9c4
% 1: CIST Bridge Id 800064006ac779a0
% 1: 10 topology change(s)  - last topology change Fri Nov 25 21:21:05 2016

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Disabled -
State Forwarding
%   ge2: Designated External Path Cost 0 -Internal Path Cost 20000
%   ge2: Configured Path Cost 20000  - Add type Explicit ref count 2
%   ge2: Designated Port Id 0x838a - CIST Priority 128  -
%   ge2: Message Age 0 - Max Age 20
%   ge2: CIST Hello Time 2 - Forward Delay 15
%   ge2: CIST Forward Timer 0 - Msg Age Timer 4 - Hello Timer 0 - topo change
timer 0
%   ge2: forward-transitions 2
%   ge2: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   ge2: No portfast configured - Current  portfast off
%   ge2: bpdu-guard  default  - Current bpdu-guard off
%   ge2: bpdu-filter default  - Current bpdu-filter off
%   ge2: no root guard configured     - Current root guard off
%   ge2: Configured Link Type point-to-point - Current point-to-point
%   ge2: No auto-edge configured - Current port Auto Edge off
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Rootport -
State Forwarding
%   ge3: Designated External Path Cost 0 -Internal Path Cost 20000
%   ge3: Configured Path Cost 20000  - Add type Explicit ref count 2
%   ge3: Designated Port Id 0x838b - CIST Priority 128  -
%   ge3: CIST Root 80003417ebfbe9c4
%   ge3: Regional Root 80003417ebfbe9c4
%   ge3: Designated Bridge 80003417ebfbe9c4
%   ge3: Message Age 0 - Max Age 20
%   ge3: CIST Hello Time 2 - Forward Delay 15
%   ge3: CIST Forward Timer 0 - Msg Age Timer 4 - Hello Timer 1 - topo change
timer 0
%   ge3: forward-transitions 3
%   ge3: Version Multiple Spanning Tree Protocol - Received MSTP - Send MSTP
%   ge3: No portfast configured - Current  portfast off
%   ge3: bpdu-guard  default  - Current bpdu-guard off
%   ge3: bpdu-filter default  - Current bpdu-filter off
%   ge3: no root guard configured     - Current root guard off
%   ge3: Configured Link Type point-to-point - Current point-to-point
%   ge3: No auto-edge configured - Current port Auto Edge off

% Instance  2:  Vlans: 2

% 1: MSTI Root Path Cost 0 -MSTI Root Port 0 - MSTI Bridge Priority 32768
% 1: MSTI Root Id 800264006ac779a0
% 1: MSTI Bridge Id 800264006ac779a0
```

```
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Disabled -
State Discarding
%   ge2: Designated Internal Path Cost 0  - Designated Port Id 0x8389
%   ge2: Configured Internal Path Cost 20000
%   ge2: Configured CST External Path cost 20000
%   ge2: CST Priority 128  - MSTI Priority 128
%   ge2: Designated Root 800264006ac779a0
%   ge2: Designated Bridge 800264006ac779a0
%   ge2: Message Age 0
%   ge2: Hello Time 2 - Forward Delay 15
%   ge2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0

% Instance  3:  Vlans: 3

% 1: MSTI Root Path Cost 20000 -MSTI Root Port 5004 - MSTI Bridge Priority
32768
% 1: MSTI Root Id 80033417ebfbe9c4
% 1: MSTI Bridge Id 800364006ac779a0
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Rootport -
State Forwarding
%   ge3: Designated Internal Path Cost 0  - Designated Port Id 0x838b
%   ge3: Configured Internal Path Cost 20000
%   ge3: Configured CST External Path cost 20000
%   ge3: CST Priority 128  - MSTI Priority 128
%   ge3: Designated Root 80033417ebfbe9c4
%   ge3: Designated Bridge 800364006ac779a0
%   ge3: Message Age 0
%   ge3: Hello Time 2 - Forward Delay 15
%   ge3: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 1
```

STP Configuration

Bridge 1

Disabling STP globally

`Bridge1(config)#no bridge 1 spanning-tree enable bridge-forward`	Disable spanning tree globally for STP.

Disabling STP per port

`Bridge1(config)#interface ge2`	Enter interface mode for ge2.
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for STP and put port on forwarding state. This command disables any type of STP on the port.

Bridge 2

Disabling STP globally

`Bridge2(config)#no bridge 1 spanning-tree enable bridge-forward`	Disable spanning tree globally for STP.

Disabling STP per port

`Bridge2(config)#interface xe2`	Enter interface mode for xe2.
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for STP and put port on forwarding state. This command disables any type of STP on the port.

Validation

Bridge 1

Verify STP details when stp is enabled globally and ge2 and ge3 are part of the bridge using the `show spanning-tree` command.

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled - topology change
% 1: Root Path Cost 4 - Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Root port 905
% 1: Root Id 80003417ebfbe9c4
% 1: Bridge Id 800064006ac779a0
% 1: 3 topology changes - last topology change Tue Nov 15 21:33:53 2016
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec

%ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - path cost 4 -
designated cost 0
%ge2: Designated Port Id 0x838a - state Forwarding -Priority 128
%ge2: Designated root 80003417ebfbe9c4
%ge2: Designated Bridge 80003417ebfbe9c4
%ge2: Message Age 0 - Max Age 20
%ge2: Hello Time 2 - Forward Delay 15
%ge2: Forward Timer 0 - Msg Age Timer 18 - Hello Timer 1 - topo change  timer0
%ge2: forward-transitions 1
%ge2: No portfast configured – Current  portfast
%ge2: bpdu-guard default- Current bpdu-guard off
%ge2: bpdu-filter default- Current bpdu-filter off
%ge2: no root guard configured- Current root guard off
%ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - path cost 4 -
designated cost 0
%ge3: Designated Port Id 0x838b - state Blocked -Priority 128
%ge3: Designated root 80003417ebfbe9c4
%ge3: Designated Bridge 80003417ebfbe9c4
%ge3: Message Age 0 - Max Age 20
%ge3: Hello Time 2 - Forward Delay 15
%ge3: Forward Timer 0 - Msg Age Timer 19 - Hello Timer 1 - topo change timer0
%ge3: forward-transitions 0
%ge3: No portfast configured - Currentportfast off
%ge3: bpdu-guarddefault- Current bpdu-guard off
%ge3: bpdu-filter default- Current bpdu-filter off
%ge3: no root guard configured- Current root guard off
%
```

Verify STP configurations when STP is enabled globally.

```
#show running-config
!
bridge 1 protocol ieee vlan-bridge
!
```

Verify STP configurations when STP is disabled globally.

```
#show running-config
!
bridge 1 protocol ieee vlan-bridge
no bridge 1 spanning-tree enable bridge-forward
!
```

Verify STP configurations when spanning-tree is enabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1
switchport mode trunk
switchport trunk allowed vlan all
!
```

Verify STP configurations when spanning-tree is disabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1 spanning-tree disable
switchport mode trunk
switchport trunk allowed vlan all
!
```

Verify STP details after disabling spanning-tree on interface ge2 with the `show spanning-tree` command.

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled
% 1: Root Path Cost 4 - Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6 -
Root port 908
% 1: Root Id 80003417ebfbe9c4
% 1: Bridge Id 800064006ac779a0
% 1: 5 topology changes - last topology change Fri Nov 25 21:15:35 2016
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - path cost 4 -
designated cost 0
%   ge2: Designated Port Id 0x838a - state Disabled -Priority 128
%   ge2: Message Age 0 - Max Age 20
%   ge2: Hello Time 2 - Forward Delay 15
%   ge2: Forward Timer 0 - Msg Age Timer 18 - Hello Timer 0 - topo change
timer 23
%   ge2: forward-transitions 2
%   ge2: No portfast configured - Current  portfast off
%   ge2: bpdu-guard  default  - Current bpdu-guard off
%   ge2: bpdu-filter default  - Current bpdu-filter off
%   ge2: no root guard configured     - Current root guard off
%
```

```
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - path cost 4 -
designated cost 0
%   ge3: Designated Port Id 0x838b - state Forwarding -Priority 128
%   ge3: Designated root 80003417ebfbe9c4
%   ge3: Designated Bridge 80003417ebfbe9c4
%   ge3: Message Age 0 - Max Age 20
%   ge3: Hello Time 2 - Forward Delay 15
%   ge3: Forward Timer 0 - Msg Age Timer 19 - Hello Timer 1 - topo change
timer 23
%   ge3: forward-transitions 2
%   ge3: No portfast configured - Current  portfast off
%   ge3: bpdu-guard  default  - Current bpdu-guard off
%   ge3: bpdu-filter default  - Current bpdu-filter off
%   ge3: no root guard configured     - Current root guard off
```

RSTP Configuration

Bridge 1

Disabling RSTP globally

`Bridge1(config)#no bridge 1 rapid-spanning-tree enable bridge-forward`	Disable spanning tree globally for RSTP.

Disabling RSTP per port

`Bridge1(config)#interface ge2`	Enter interface mode for ge2.
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for RSTP and put port on forwarding state. This command disables any type of STP on the port.

Bridge 2

Disabling RSTP globally

`Bridge2(config)#no bridge 1 rapid-spanning-tree enable bridge-forward`	Disable spanning tree globally for RSTP.

Disabling RSTP per port

`Bridge2(config)#interface xe2`	Enter interface mode for xe2.
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree per port for RSTP and put port on forwarding state. This command disables any type of STP on the port.

Validation

Bridge 1

Verify RSTP details when rstp is enabled globally and ge2 and ge3 are part of the bridge using the `show spanning-tree` command.

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled- topology change detected
% 1: Root Path Cost 20000 - Root Port 905 -Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 80003417ebfbe9c4
% 1: Bridge Id 800064006ac779a0
% 1: last topology change Tue Nov 15 21:44:31 2016
% 1: 7 topology change(s)- last topology change Tue Nov 15 21:44:31 2016
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
% ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Rootport - State
Forwarding
% ge2: Designated Path Cost 0
% ge2: Configured Path Cost 20000- Add type Explicit ref count 1
% ge2: Designated Port Id 0x838a - Priority 128-
% ge2: Root 80003417ebfbe9c4
% ge2: Designated Bridge 80003417ebfbe9c4
% ge2: Message Age 0 - Max Age 20
% ge2: Hello Time 2 - Forward Delay 15
% ge2: Forward Timer 0 - Msg Age Timer 4 - Hello Timer 1 - topo change timer
0
% ge2: forward-transitions 1
% ge2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
% ge2: No portfast configured - Currentportfast off
% ge2: bpdu-guarddefault- Current bpdu-guard off
% ge2: bpdu-filter default- Current bpdu-filter off
% ge2: no root guard configured- Current root guard off
% ge2: Configured Link Type point-to-point - Current point-to-point
% ge2: No auto-edge configured - Current port Auto Edge off
% ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Alternate -
State Discarding
% ge3: Designated Path Cost 0
% ge3: Configured Path Cost 20000- Add type Explicit ref count 1
% ge3: Designated Port Id 0x838b - Priority 128-
% ge3: Root 80003417ebfbe9c4
% ge3: Designated Bridge 80003417ebfbe9c4
% ge3: Message Age 0 - Max Age 20
% ge3: Hello Time 2 - Forward Delay 15
% ge3: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change timer
0
% ge3: forward-transitions 2
% ge3: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
% ge3: No portfast configured - Currentportfast off
% ge3: bpdu-guarddefault- Current bpdu-guard off
% ge3: bpdu-filter default- Current bpdu-filter off
% ge3: no root guard configured- Current root guard off
% ge3: Configured Link Type point-to-point - Current point-to-point
% ge3: No auto-edge configured - Current port Auto Edge off
```

```
%
```

Verify RSTP configurations when RSTP is enabled globally.

```
#show running-config
!
bridge 1 protocol rstp vlan-bridge
!
```

- Verify RSTP configurations when RSTP is disabled globally

```
#show running-config
!
bridge 1 protocol rstp vlan-bridge
no bridge 1 rapid-spanning-tree enable bridge-forward
!
```

Verify RSTP configurations when spanning-tree is enabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1
switchport mode trunk
switchport trunk allowed vlan all
!
```

Verify RSTP configurations when spanning-tree is enabled on interface.

```
#show running-config interface ge2
!
interface ge2
switchport
bridge-group 1 spanning-tree disable
switchport mode trunk
switchport trunk allowed vlan all
```

Verify RSTP details after disabling spanning-tree on interface ge2 with the `show spanning-tree` command.

```
#sh spanning-tree
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 20000 - Root Port 908 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 80003417ebfbe9c4
% 1: Bridge Id 800064006ac779a0
% 1: last topology change Fri Nov 25 21:08:56 2016
% 1: 11 topology change(s)  - last topology change Fri Nov 25 21:08:56 2016
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   ge2: Port Number 905 - Ifindex 5001 - Port Id 0x8389 - Role Disabled -
State Forwarding
%   ge2: Designated Path Cost 0
%   ge2: Configured Path Cost 20000  - Add type Explicit ref count 1
%   ge2: Designated Port Id 0x838a - Priority 128  -
%   ge2: Message Age 0 - Max Age 20
%   ge2: Hello Time 2 - Forward Delay 15
%   ge2: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 0 - topo change timer
0
%   ge2: forward-transitions 2
```

```
%   ge2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   ge2: No portfast configured - Current  portfast off
%   ge2: bpdu-guard  default  - Current bpdu-guard off
%   ge2: bpdu-filter default  - Current bpdu-filter off
%   ge2: no root guard configured     - Current root guard off
%   ge2: Configured Link Type point-to-point - Current point-to-point
%   ge2: No auto-edge configured - Current port Auto Edge off
%
%   ge3: Port Number 908 - Ifindex 5004 - Port Id 0x838c - Role Rootport -
State Forwarding
%   ge3: Designated Path Cost 0
%   ge3: Configured Path Cost 20000  - Add type Explicit ref count 1
%   ge3: Designated Port Id 0x838b - Priority 128  -
%   ge3: Root 80003417ebfbe9c4
%   ge3: Designated Bridge 80003417ebfbe9c4
%   ge3: Message Age 0 - Max Age 20
%   ge3: Hello Time 2 - Forward Delay 15
%   ge3: Forward Timer 0 - Msg Age Timer 5 - Hello Timer 1 - topo change timer
0
%   ge3: forward-transitions 3
%   ge3: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%   ge3: No portfast configured - Current  portfast off
%   ge3: bpdu-guard  default  - Current bpdu-guard off
%   ge3: bpdu-filter default  - Current bpdu-filter off
%   ge3: no root guard configured     - Current root guard off
%   ge3: Configured Link Type point-to-point - Current point-to-point
%   ge3: No auto-edge configured - Current port Auto Edge off
```

CHAPTER 7 RPVST+ Configuration

This chapter contains a complete example of an RPVST+ configuration.

Topology

Figure 7-7: RPVST+ configuration

Configuration

Switch 2

`#configure terminal`	Enter configure mode for the switch.
`(config)#bridge 1 protocol rpvst+`	Configure bridge 1 as an RPVST+ bridge.
`(config)#vlan 2-3 bridge 1`	Configure VLAN 2 and 3 and associate it to bridge 1.
`(config)#spanning-tree rpvst+ configuration`	Enter Rapid Per-VLAN Spanning Tree configuration mode.
`(config-rpvst+)#bridge 1 vlan 2`	Associate a configured VLAN with bridge 1.
`(config-rpvst+)#bridge 1 vlan 3`	Associate a configured VLAN with bridge 1,.
`(config-rvpst+)#exit`	Exit RPVST+ configuration mode.
`(config)#interface eth1`	Enter interface mode for eth1
`(config-if)#switchport`	Configure eth1 as a Layer 2 port.
`(config-if)#bridge-group 1`	Associate bridge to interface.
`(config-if)#switchport mode trunk`	Configure port as trunk.
`(config-if)#switchport trunk allowed vlan add 2,3`	Configure VLAN 2 and VLAN 3 on interface.
`(config-if)#bridge-group 1 vlan 2`	Configure bridge group to interface with VLAN 2.
`(config-if)#bridge-group 1 vlan 3`	Configure bridge group to interface with VLAN 3.
`(config-if)#exit`	Exit interface mode.
`(config)#interface eth2`	Enter interface mode for eth2.
`(config-if)#switchport`	Configure eth2 as a Layer 2 port.
`(config-if)#bridge-group 1`	Associate bridge to interface/
`(config-if)#switchport mode trunk`	Configure port as trunk
`(config-if)#switchport trunk allowed vlan add 2,3`	Configure VLAN 2 and VLAN 3 on interface.
`(config-if)#bridge-group 1 vlan 2`	Configure bridge group to interface with VLAN 2.
`(config-if)#bridge-group 1 vlan 3`	Configure bridge group to interface with VLAN3.
`(config-if)#exit`	Exit interface mode.

Switch 1

`#configure terminal`	Enter configure mode for the switch.
`(config)#bridge 1 protocol rpvst+`	Configure bridge 1 as an rpvst+ bridge.
`(config)#vlan 2-3 bridge 1`	Configure VLAN 2 and 3 and associate it to bridge 1.
`(config)#spanning-tree rpvst+ configuration`	Enter Rapid Per-VLAN Spanning Tree configuration mode.
`(config-rpvst+)#bridge 1 vlan 2`	Associate a configured VLAN with bridge 1.
`(config-rpvst+)#bridge 1 vlan 3`	Associate a configured VLAN with bridge 1.
`(config-rvpst+)#exit`	Exit RPVST+ configuration mode.
`(config)#interface eth1`	Enter interface mode for eth1.
`(config-if)#switchport`	Configure eth1 as a Layer 2 port.
`(config-if)#bridge-group 1`	Associate bridge to interface.
`(config-if)#switchport mode trunk`	Configure port as trunk.
`(config-if)#switchport trunk allowed vlan add 2,3`	Configure VLAN 2 and VLAN 3 on interface.
`(config-if)#bridge-group 1 vlan 2`	Configure bridge group to interface with VLAN 2.
`(config-if)#bridge-group 1 vlan 3`	Configure bridge group to interface with VLAN3.
`(config-if)#exit`	Exit interface mode.

Switch 3

`#configure terminal`	Enter configure mode for the switch.
`(config)#bridge 1 protocol rpvst+`	Configure bridge 1 as an rpvst+ bridge
`(config)#vlan 2-3 bridge 1`	Configure VLAN 2 and 3 and associate it to bridge 1.
`(config)#interface eth1`	Enter interface mode for eth1.
`(config-if)#switchport`	Configure eth1 as a Layer 2 port.
`(config-if)#bridge-group 1`	Associate bridge to interface.
`(config-if)#switchport mode trunk`	Configure port as trunk.
`(config-if)#switchport trunk allowed vlan add 2,3`	Configure VLAN 2 and VLAN 3 on interface.
`(config-if)#exit`	Exit interface mode.

Validation

Switch2

```
#show spanning-tree rpvst+ vlan 2
% vlan 2 Instance 1 configured
% 1: Root Path Cost 0 - Root Port 0 - Bridge Priority 32768
% 1: Root Id 8002525400b7bfa7
% 1: Bridge Id 8002525400b7bfa7
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
```

```
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8002525400b7bfa7
%   eth1: Designated Bridge 8002525400b7bfa7
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 200000
%   eth2: Configured External Path cost 200000
%   eth2: Configured Internal Priority 128
%   eth2: Configured External Priority 128
%   eth2: Designated Root 8002525400b7bfa7
%   eth2: Designated Bridge 8002525400b7bfa7
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1
%

#show spanning-tree rpvst+ interface eth1
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8001525400b7bfa7
% 1: Bridge Id 8001525400b7bfa7
% 1: last topology change Wed Mar 28 15:33:06 2018
% 1: 2 topology change(s)  - last topology change Wed Mar 28 15:33:06 2018

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 0
%   eth1: Configured Path Cost 200000  - Add type Explicit ref count 3
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8001525400b7bfa7
%   eth1: Designated Bridge 8001525400b7bfa7
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 2 - topo change timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
```

```
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%
%   Instance        VLAN
%   0:              1
%   1:              2
%   2:              3



#show spanning-tree rpvst+ detail
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8001525400b7bfa7
% 1: Bridge Id 8001525400b7bfa7
% 1: last topology change Wed Mar 28 15:33:06 2018
% 1: 2 topology change(s)  - last topology change Wed Mar 28 15:33:06 2018

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 0
%   eth1: Configured Path Cost 200000  - Add type Explicit ref count 3
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8001525400b7bfa7
%   eth1: Designated Bridge 8001525400b7bfa7
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated External Path Cost 0 -Internal Path Cost 0
%   eth2: Configured Path Cost 200000  - Add type Explicit ref count 3
%   eth2: Designated Port Id 0x8004 - Priority 128  -
```

```
%   eth2: Root 8001525400b7bfa7
%   eth2: Designated Bridge 8001525400b7bfa7
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change timer 0
%   eth2: forward-transitions 1
%   eth2: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth2: No portfast configured - Current  portfast off
%   eth2: bpdu-guard  default  - Current bpdu-guard off
%   eth2: bpdu-filter default  - Current bpdu-filter off
%   eth2: no root guard configured     - Current root guard off
%   eth2: Configured Link Type point-to-point - Current point-to-point
%   eth2: No auto-edge configured - Current port Auto Edge off
%


% Instance  1:  Vlans: 2
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8002525400b7bfa7
%   eth1: Designated Bridge 8002525400b7bfa7
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0


% Instance  1:  Vlans: 2
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 200000
%   eth2: Configured External Path cost 200000
%   eth2: Configured Internal Priority 128
%   eth2: Configured External Priority 128
%   eth2: Designated Root 8002525400b7bfa7
%   eth2: Designated Bridge 8002525400b7bfa7
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1


% Instance  2:  Vlans: 3
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
```

```
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8003525400b7bfa7
%   eth1: Designated Bridge 8003525400b7bfa7
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0


% Instance  2:  Vlans: 3
%   eth2: Port Number 4 - Ifindex 4 - Port Id 0x8004 - Role Designated - State
Forwarding
%   eth2: Designated Internal Path Cost 0  - Designated Port Id 0x8004
%   eth2: Configured Internal Path Cost 200000
%   eth2: Configured External Path cost 200000
%   eth2: Configured Internal Priority 128
%   eth2: Configured External Priority 128
%   eth2: Designated Root 8003525400b7bfa7
%   eth2: Designated Bridge 8003525400b7bfa7
%   eth2: Message Age 0 - Max Age 20
%   eth2: Hello Time 2 - Forward Delay 15
%   eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1
```

CHAPTER 8 Link Aggregation Configuration

This chapter contains a complete sample Link Aggregation Group configuration.

LACP is based on the 802.3ad IEEE specification. It allows bundling of several physical interfaces to form a single logical channel providing enhanced performance and redundancy. The aggregated interface is viewed as a single link to each switch. The spanning tree views it as one interface and not as two or three interfaces. When there is a failure in one physical interface, the other interfaces stay up and there is no disruption. Traffic can be load balanced within an LACP trunk group in a controlled manner using the hashing algorithm.The maximum number of physical Ethernet links in a single logical channel depends upon the hardware support.

Note:

- Physical interfaces will inherit the properties of LAG port once it is attached to be part of LAG, irrespective of the configuration present on the physical interface.
- In case of Dynamic LAG and Static LAG, member ports could be moved from one LAG to another LAG, without unconfiguring the member port.
- LAG port should be configured as a switch or router port, before adding member ports into it.

Topology

In Figure 8-8, 3 links are configured between the two switches S1 and S2. These three links are assigned the same administrative key (1) so that they aggregate to form a single channel 1. They are viewed by the STP as one interface.

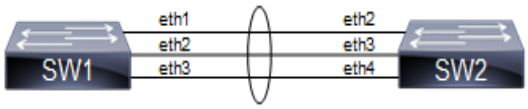


Figure 8-8: LACP Topology

Dynamic LAG Configuration

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)# bridge 1 protocol mstp`	Configure bridge 1 as MSTP bridge
`SW1(config)#lacp system-priority 20000`	Set the system priority of this switch. This priority is used for determining the system that is responsible for resolving conflicts in the choice of aggregation groups. A lower numerical value has a higher priority.
`SW1(config)#interface po10`	Enter into port channel interface po10.
`SW1(config-if)#switchport`	Configure po10 as a layer 2 port.
`SW1(config-if)#bridge-group 1`	Associate bridge to an interface.
`SW1(config-if)#switchport mode trunk`	Configure port as a trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the po10 interface.
`SW1(config-if)#exit`	Exit interface mode.
`SW1(config)#interface eth1`	Enter interface mode.

`SW1(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
`SW1(config-if)#exit`	Exit interface mode.
`SW1(config)#interface eth2`	Enter interface mode.
`SW1(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
`SW1(config-if)#exit`	Exit interface mode.
`SW1(config)#interface eth3`	Enter interface mode.
`SW1(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)# bridge 1 protocol mstp`	Configure bridge 1 as MSTP bridge
`SW2(config)#lacp system-priority 20000`	Set the system priority of this switch. This priority is used for determining the system that is responsible for resolving conflicts in the choice of aggregation groups. A lower numerical value has a higher priority.
`SW2(config)#interface po10`	Enter into port channel interface po10.
`SW2(config-if)#switchport`	Configure po10 as a layer 2 port.
`SW2(config-if)#bridge-group 1`	Associate bridge to an interface.
`SW2(config-if)#switchport mode trunk`	Configure port as a trunk.
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all the VLANs on the po10 interface.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface eth2`	Enter interface mode.
`SW2(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface eth3`	Enter interface mode.
`SW2(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface eth4`	Enter interface mode.
`SW2(config-if)#channel-group 10 mode active`	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.

Validation

show etherchannel detail, show etherchannel summary, show running-config interface po10, show running-config interface eth1

```
#show etherchannel detail
% Aggregator po10 7
% Aggregator Type: Layer2
%  Mac address: 08:00:27:50:6a:9b
%  Admin Key: 0010 - Oper Key 0010
%  Actor LAG ID- 0x4e20,08-00-27-ab-ea-38,0x000a
%  Receive link count: 3 - Transmit link count: 3
%  Individual: 0 - Ready: 1
%  Partner LAG ID- 0x4e20,08-00-27-f8-3c-30,0x000a
%   Link: eth1 (3) sync: 1
%   Link: eth2 (4) sync: 1
%   Link: eth3 (5) sync: 1
%   Collector max delay: 5

#show etherchannel summary
% Aggregator po10 7
% Aggregator Type: Layer2
% Admin Key: 0010 - Oper Key 0010
% Aggregator Type: Layer2
%   Link: eth1 (3) sync: 1
%   Link: eth2 (4) sync: 1
%   Link: eth3 (5) sync: 1

#show running-config interface po10
!
interface po10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all

#show running-config interface eth1
!
interface eth1
 channel-group 10 mode active
```

Static LAG Configuration

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)# bridge 1 protocol mstp`	Configure bridge 1 as MSTP bridge
`SW1(config)#lacp system-priority 20000`	Set the system priority of this switch. This priority is used for determining the system that is responsible for resolving conflicts in the choice of aggregation groups. A lower numerical value has a higher priority.
`SW1(config)#interface sa10`	Enter into port channel interface sa10.

SW1(config-if)#switchport	Configure sa10 as a layer 2 port.
SW1(config-if)#bridge-group 1	Associate bridge to an interface.
SW1(config-if)#switchport mode trunk	Configure port as a trunk.
SW1(config-if)#switchport trunk allowed vlan all	Allow all the VLANs on the po10 interface.
SW1(config-if)#exit	Exit interface mode.
SW1(config)#interface eth1	Enter interface mode.
SW1(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
SW1(config-if)#exit	Exit interface mode.
SW1(config)#interface eth2	Enter interface mode.
SW1(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
SW1(config-if)#exit	Exit interface mode.
SW1(config)#interface eth3	Enter interface mode.
SW1(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
SW1(config-if)#exit	Exit interface mode.

SW2

SW2#configure terminal	Enter configure mode.
SW2(config)# bridge 1 protocol mstp	Configure bridge 1 as MSTP bridge
SW2(config)#lacp system-priority 20000	Set the system priority of this switch. This priority is used for determining the system that is responsible for resolving conflicts in the choice of aggregation groups. A lower numerical value has a higher priority.
SW2(config)#interface sa10	Enter into port channel interface sa10.
SW2(config-if)#switchport	Configure sa10 as a layer 2 port.
SW2(config-if)#bridge-group 1	Associate bridge to an interface.
SW2(config-if)#switchport mode trunk	Configure port as a trunk.
SW2(config-if)#switchport trunk allowed vlan all	Allow all the VLANs on the po10 interface.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface eth2	Enter interface mode.
SW2(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface eth3	Enter interface mode.
SW2(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.

SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface eth4	Enter interface mode.
SW2(config-if)#static-channel-group 10	Add this interface to channel group 10 and enable link aggregation so that it can be selected for aggregation by the local system.
SW2(config-if)#exit	Exit interface mode.

Validation

```
#show static-channel-group
% Static Aggregator: sa10
% Member status:
   eth1    up
   eth2    up
   eth3    up

#show running-config interface sa10
!
interface sa10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all

#show running-config interface eth1
!
interface eth1
 static-channel-group 10
```

Static LAG Minimum Link Configuration

Configure the minimum number of ports that must be linked up and bundled in the LACP port channel. We can configure the minimum links range from 2 to 32. If the number of ports aggregated to the port channel is less than the minimum number of links configured, then the port channel enters the Protocol Down because of the minimum link state.

Note: Minimum links should be configured the same on both sides for optimal performance.

Topology

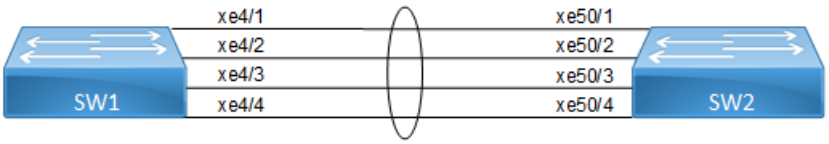


Figure 8-9: LAG Minimum Link

SW1

`#configure terminal`	Enter configure mode.
`(config)#interface sa10`	Creating interface static-lag sa10
`(config-if)#port-channel min-links 4`	Configuring port channel minimum links as 4(range is 2-32)
`(config-if)#end`	Exit the configure mode

Validation

SW1

```
#show static-channel-group 10
% Static Aggregator: sa10
% Minimum-Links 4
% Member status:
         xe4/1     up
         xe4/2     up
         xe4/3     up
         xe4/4     up


#show running-config interface sa10
!
interface sa10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-links 4
```

SW2

`#configure terminal`	Enter configure mode.
`(config)#interface sa10`	Creating interface port-channel sa10
`(config-if)#port-channel min-links 4`	Configuring port channel minimum links as 4 (range is 2-32)
`(config-if)#exit`	Exit the configure mode

Validation

SW2

```
#show running-config interface sa10
!
interface sa10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-links 4
!

#show static-channel-group 10
% Static Aggregator: sa10
% Minimum-Links 4
% Member status:
         Xe50/1     up
         Xe50/2     up
         Xe50/3     up
         Xe50/4     up


Note:When a sa goes down due to the minimum links configured (number of
minimum links is greater than the links aggregated to the sa).
Rtr1:
=====
#sh int brief sa10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


--------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
```

```
Interface
------------------------------------------------------------------------------
--
sa10         AGG    1     trunk              down      PD(Min L/B)   0
#

Rtr2:
=====

#sh int brief sa10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


------------------------------------------------------------------------------
--
Port-channel  Type   PVID  Mode               Status    Reason   Speed
Interface
------------------------------------------------------------------------------
--
sa10         AGG    1     trunk              down      PD(Min L/B)   0
#
```

Static-LAG Minimum Bandwidth Configuration

Configure the minimum bandwidth allowed for ports that must be linked up and bundled in the LACP port channel. We can configure the minimum bandwidth range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits. If the Total bandwidth of ports aggregated to the port channel is less than the minimum Bandwidth value configured, then the port channel enters the Protocol Down because of the minimum Bandwidth state.

Note: Minimum Bandwidth should be configured the same on both sides for optimal performance.

Topology

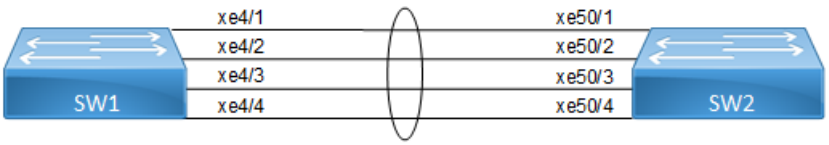


Figure 8-10: LAG Minimum Bandwidth

SW1

`#configure terminal`	Enter configure mode.
`(config)#interface sa10`	Creating interface static-lag sa10
`(config-if)#port-channel min-bandwidth 40g`	Configuring port channel minimum bandwidth as 40g (range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits.)
`(config-if)#end`	Exit the configure mode

Validation

SW1

```
#show static-channel-group 10
% Static Aggregator: sa10
% Minimum- 4
% Member status:
         xe4/1     up
         xe4/2     up
         xe4/3     up
         xe4/4     up



#show running-config interface sa10
!
interface sa10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-bandwidth 40g
```

SW2

`#configure terminal`	Enter configure mode.
`(config)#interface sa10`	Creating interface port-channel sa10
`(config-if)#port-channel min-bandwidth 40g`	Configuring port channel minimum bandwidth as 40g (range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits.)
`(config-if)#exit`	Exit the configure mode

Validation

SW2

```
#show running-config interface sa10
!
interface sa10
 switchport
```

```
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-bandwidth 40g
!

#show static-channel-group 10
% Static Aggregator: sa10
% Minimum-bandwidth 40g
% Member status:
         Xe50/1     up
         Xe50/2     up
         Xe50/3     up
         Xe50/4     up
```

Note: When sa goes down due to [Total Bandwidth of sa] <[Minimum Bandwidth value Configured]

```
SW1:
=====
#sh int brief sa10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD - ESI Hold Timer Down


--------------------------------------------------------------------------------
--
Port-channel Type PVID Mode              Status   Reason Speed
Interface
--------------------------------------------------------------------------------
--
sa10         AGG   1     trunk             down     PD(Min L/B)  0
#


SW2:
=====

#sh int brief sa10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
```

```
        PD(Min L/B) - Protocol Down Min-Links/Bandwidth
        DV - DDM Violation, NA - Not Applicable
        NOM - No operational members, PVID - Port Vlan-id
        Ctl - Control Port (Br-Breakout/Bu-Bundle)
        HD  - ESI Hold Timer Down


-------------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
Interface
-------------------------------------------------------------------------------
--
sa10          AGG   1     trunk             down     PD(Min L/B)  0
#
```

Dynamic-LAG Minimum Link Configuration

Configure the minimum number of ports that must be linked up and bundled in the LACP port channel. We can configure the minimum links range from 2 to 32. If the number of ports aggregated to the port channel is less than the minimum number of links configured, then the port channel enters the Protocol Down because of the minimum link state.

Note: Minimum links should be configured the same on both sides for optimal performance.

Topology

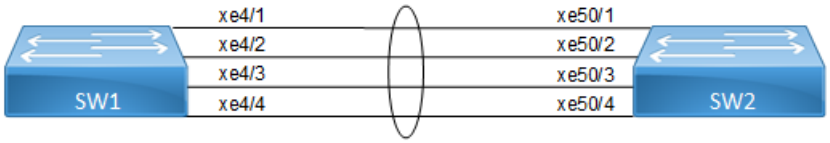


Figure 8-11: LAG Minimum Link

SW1

`#configure terminal`	Enter configure mode.
`(config)#interface po10`	Creating interface port-channel po10
`(config-if)#port-channel min-links 4`	Configuring port channel minimum links as 4 (range is 2-32)
`(config-if)#end`	Exit the configure mode

Validation

SW1

```
#sh running-config interface po10

interface po10
 switchport
 bridge-group 1
 switchport mode trunk
```

```
 switchport trunk allowed vlan all
port-channel min-links 4
!

!

#show etherchannel
-------------------------------------
% Lacp Aggregator: po10
% Min-links : 4
% Member:
   xe4/1
   xe4/2
   xe4/3
   xe4/4
-------------------------------------

#show etherchannel summary

% Aggregator po10 100010
% Aggregator Type: Layer2
% Admin Key: 0010 - Oper Key 0010
%   Link: xe4/4 (10072) sync: 1
%   Link: xe4/1 (10069) sync: 1
%   Link: xe4/2 (10070) sync: 1
%   Link: xe4/3 (10071) sync: 1
--------------------------------------
```

SW2

`#configure terminal`	Enter configure mode.
`(config)#interface po10`	Creating interface port-channel po10
`(config-if)#port-channel min-links 4`	Configuring port channel minimum links as 4 (range is 2-32)
`(config-if)#exit`	Exit the configure mode

Validation

SW2

```
#show running-config interface po10
!
interface po10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-links 4
!

#show etherchannel

% Aggregator Type: Layer2
% Lacp Aggregator: po10
```

```
% Min-links: 4
% Member:
   xe50/1
   xe50/2
   xe50/3
   xe50/4

#show etherchannel summary

% Aggregator po10 100010
% Aggregator Type: Layer2
% Admin Key: 0010 - Oper Key 0010
%   Link: xe50/4 (10072) sync: 1
%   Link: xe50/1 (10069) sync: 1
%   Link: xe50/2 (10070) sync: 1
%   Link: xe50/3 (10071) sync: 1
```

Note: When a PO goes down due to the minimum links configured (number of minimum links is greater than the links aggregated to the PO).

```
RTR1:
#sh int brief po10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


--------------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
Interface
--------------------------------------------------------------------------------
--
po10         AGG   1     trunk             down     PD(Min L/B)  0
#


#sh etherchannel
% Lacp Aggregator: po10
% Min-links: 4
% Protocol Down (Min L/B): True
% Member:
   xe4/1
   xe4/2
   xe4/3
```

```
   xe4/4

SW2:
#sh etherchannel
% Lacp Aggregator: po10
% Min-links: 4
% Protocol Down (Min L/B): True
% Member:
   Xe50/1
   Xe50/2
   Xe50/3
       xe50/4

#sh int brief po100

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


--------------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
Interface
--------------------------------------------------------------------------------
--
po10         AGG   1     trunk             down     PD(Min L/B)  0
#
```

Dynamic LAG Minimum Bandwidth Configuration

Configure the minimum bandwidth allowed for ports that must be linked up and bundled in the LACP port channel. We can configure the minimum bandwidth range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits. If the Total bandwidth of ports aggregated to the port channel is less than the minimum Bandwidth value configured, then the port channel enters the Protocol Down because of the minimum Bandwidth state.

Note: Minimum Bandwidth should be configured the same on both sides for optimal performance.

Topology

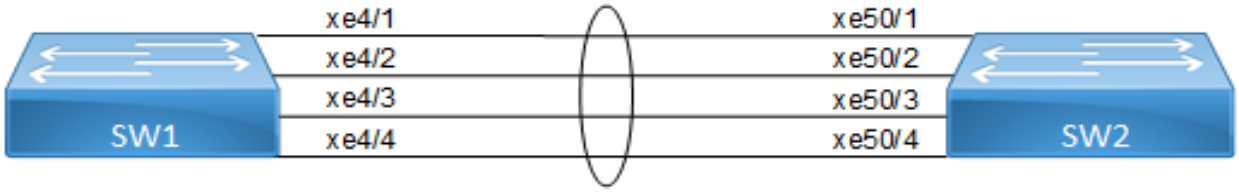


Figure 8-12: LAG Minimum Bandwidth

SW1

`#configure terminal`	Enter configure mode.
`(config)#interface po10`	Creating interface port-channel po10
`(config-if)#port-channel min-bandwidth 40g`	Configuring port channel minimum bandwidth as 40g (range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits.)
`(config-if)#end`	Exit the configure mode

Validation

SW1

```
#sh running-config interface po10

interface po10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
port-channel min-bandwidth 40g
!

!

#show etherchannel
-------------------------------------
% Lacp Aggregator: po10
% Min-Bandwidth : 40g
% Member:
   xe4/1
   xe4/2
```

```
   xe4/3
   xe4/4
-------------------------------------

#show etherchannel summary

% Aggregator po10 100010
% Aggregator Type: Layer3
% Admin Key: 0010 - Oper Key 0010
%   Link: xe4/4 (10072) sync: 1
%   Link: xe4/1 (10069) sync: 1
%   Link: xe4/2 (10070) sync: 1
%   Link: xe4/3 (10071) sync: 1
-------------------------------------
```

SW2

`#configure terminal`	Enter configure mode.
`(config)#interface po10`	Creating interface port-channel po10
`(config-if)#port-channel min-bandwidth 40g`	Configuring port channel minimum bandwidth as 40g (range from BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits.)
`(config-if)#exit`	Exit the configure mode

Validation

SW2

```
#show running-config interface po10
!
interface po10
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 port-channel min-bandwidth 40g
!

#show etherchannel

% Lacp Aggregator: po10
% Min-Bandwidth : 40g
% Member:
   xe50/1
   xe50/2
   xe50/3
   xe50/4

#show etherchannel summary

% Aggregator po10 100010
% Aggregator Type: Layer2
% Admin Key: 0010 - Oper Key 0010
```

```
%   Link: xe50/4 (10072) sync: 1
%   Link: xe50/1 (10069) sync: 1
%   Link: xe50/2 (10070) sync: 1
%   Link: xe50/3 (10071) sync: 1
```

Note: When a PO goes down due to the [Total bandwidth] < [minimum bandwidth configured]

```
SW1:
=====
#sh int brief po10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


--------------------------------------------------------------------------------
--
Port-channel Type  PVID  Mode              Status   Reason  Speed
Interface
--------------------------------------------------------------------------------
--
po10         AGG   1     trunk             down     PD(Min L/B)  0
#


#sh etherchannel
% Lacp Aggregator: po10
% Min-Bandwidth : 40g
% Protocol Down (Min L/B): True
% Member:
   xe4/1
   xe4/2
   xe4/3
   xe4/4


SW2:
=====
#sh etherchannel
% Lacp Aggregator: po10
% Min-Bandwidth : 40g
% Protocol Down (Min L/B): True
% Member:
   Xe50/1
   Xe50/2
   Xe50/3
       xe50/4
```

```
#sh int brief po10

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


--------------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
Interface
--------------------------------------------------------------------------------
--
po10         AGG   1     trunk             down     PD(Min L/B)  0
#
```

LACP Minimum-Link, Minimum-Bandwidth on Dynamic and Static Channel-Groups with MC-LAG

Overview

OcNOS allows the configuration of minimum number of the LAG members per LAG group. Both these configurations are meaningful in case the LAG is used for incremental-BW mode. The minimum configuration controls the minimum number of members /bandwidth that must be operationally up / bandwidth available to declare their LAG as operationally UP.

When static/dynamic LAG interface configured with minimum links / minimum bandwidth, the following conditions are to be met:

- Ports which are admin and operational up are considered for min-link.
- The specified minimum number of links should be up.
- Min-link and min-bandwidth cannot co-exist.
- When ports are down due to min-link/min-bandwidth, in show interface brief command output, port down with the corresponding reason code for the failure due to min-link/min-bandwidth.

Minimum Active Members/Bandwidth

The user can specify the minimum number of members that must be operationally up to declare their LAG as operationally UP. Note that this parameter applies to static/dynamic LAG.

```
port-channel min-links <2 - 32>
```

The minimum active member configuration will be allowed to be modified to be greater than the current number of active members. In such configuration, the LAG operational status will become operationally down.

The user can specify the minimum bandwidth, based on the configured value and the ports that satisfy the conditions LAG will be operationally UP. This parameter is applied for static/dynamic LAG.

```
port-channel min-bandwidth BANDWIDTH
```

BANDWIDTH <1-999>k|m for 1 to 999 kilo bits or mega bits <1-1000>g for 1 to 1000 giga bits.

When condition fails, the operational state changes to DOWN.

Note: Do not configure minimum-link, Minimum Bandwidth both on TORS and switches at the same time to avoid flaps of MLAG.

Topology

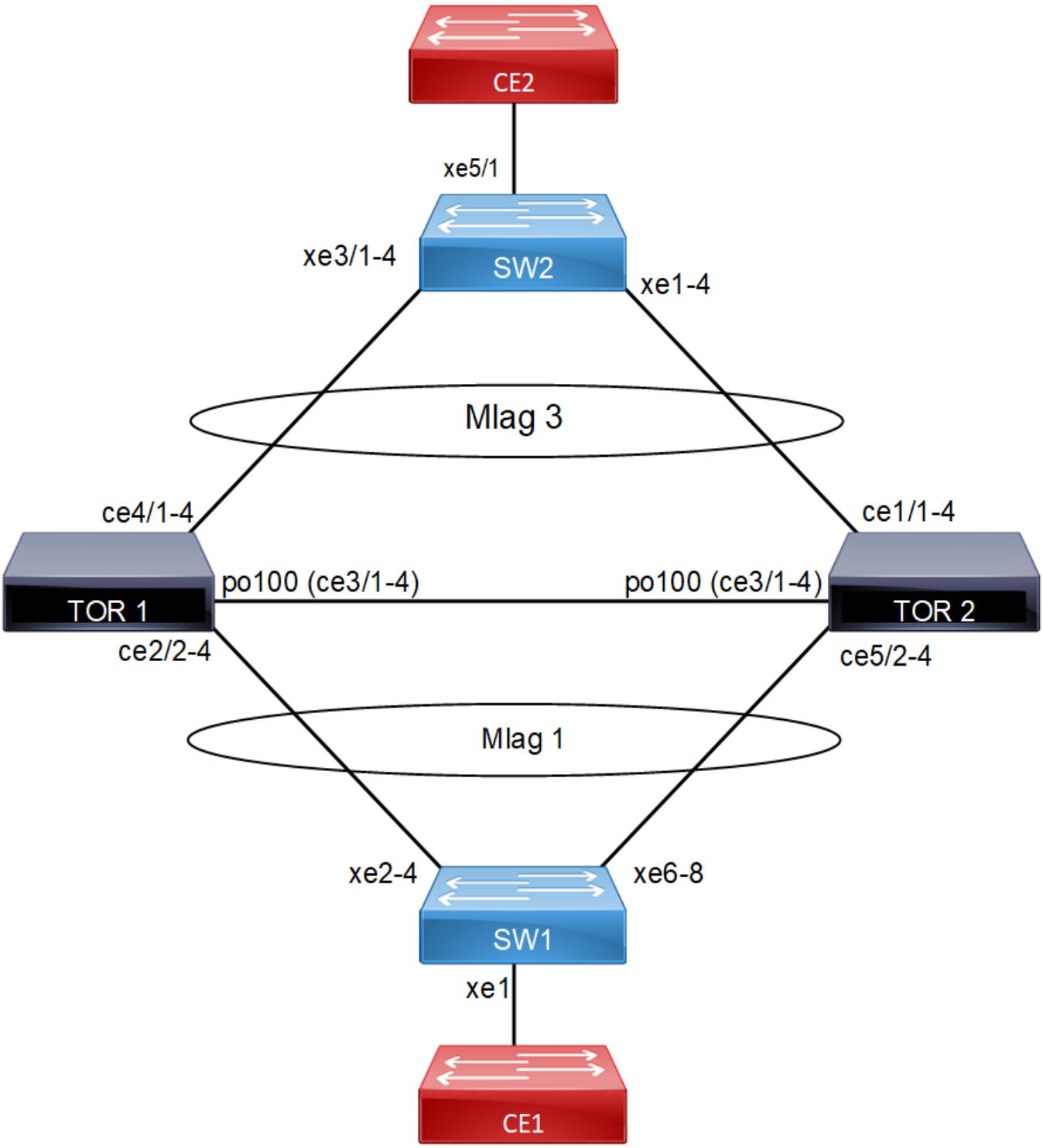


Figure 8-13: MC - LAG Topology

Configuration

TOR1:

#configure terminal	Enter configure mode.
(config)# bridge 1 protocol rstp vlan-bridge end	Configure bridge type
configure terminal	Enter Configure mode
(config)# vlan database	Enter vlan database
(config-vlan)# vlan 600 bridge 1 state enable	Configure vlans
(config-if)#end	
#configure terminal	Enter Configure mode.
(config)#interface mlag1	Enter Interface mode
(config-if)# switchport	Make mlag as layer2 port
(config-if)# bridge-group 1	Attach interface to bridge
(config-if)# switchport mode trunk	Configure trunk port
(config-if)# switchport trunk allowed vlan add 600,601,502	Add interface to vlans
(config-if)# spanning-tree edgeport	Configure port as edge port to avoid loops
(config-if)# spanning-tree bpdu-filter enable	Enable bpdu filter to avoid loops
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface mlag3	Enter Interface mode
(config-if)# switchport	Make mlag as layer2 port
(config-if)# bridge-group 1	Attach interface to bridge
(config-if)# switchport mode trunk	Configure trunk port
(config-if)# switchport trunk allowed vlan add 600,502	Add interface to vlans
(config-if)# spanning-tree edgeport	Configure port as edge port to avoid loops
(config-if)# spanning-tree bpdu-filter enable	Enable bpdu filter to avoid loops
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface po100	Enter Interface mode
(config-if)# switchport	Make po as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)# mtu 9216	Configure mtu
(config-if)#end	
#configure terminal	Enter Configure mode.
(config)#interface sa1	Enter Interface mode
(config-if)# switchport	Make sa1 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.

(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed all	Enable all VLAN identifiers on this interface.
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce2/1	Enter Interface mode
(config-if)#port breakout enable	Port breakout enabled
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce2/2	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce2/3	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce2/4	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/1	Enter Interface mode
(config-if)#port breakout enable	Port breakout enabled
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/2	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/3	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/4	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce4/1	Enter Interface mode
(config-if)#port breakout enable	Port breakout enabled
(config-if)# static-channel-group 3	Add interface to sa3

(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce4/2	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce4/3	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#mcec domain configuration	Enter Multichasis Etherchannel domain configuration mode.
(config-mcec-domain)# domain-address 1111.2222.3333	Configure the domain address.
(config-mcec-domain)# domain-system-number 1	Configure the domain system number
(config-mcec-domain)# intra-domain-link po100	Specify the intra domain link for MLAG communication
(config-mcec-domain)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#int mlag1	Enter Interface mode
(config-if)#mode active-standby	Configure mlag mode for mlag1
(config-if)#switchover type revertive 10	Configure revertive timer
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa1	Enter Interface mode
(config-if)#mlag 1	Map sa1 to mlag1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#int mlag3	Enter Interface mode
(config-if)#mode active-standby	Configure mlag mode for mlag3
(config-if)#switchover type revertive 10	Configure revertive timer
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa3	Enter Interface mode
(config-if)#mlag 3	Map sa3 to mlag3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config-if)# interface sa1	Enter sa interface mode
(config-if)#port-channel min-links 3	Configure min-link value on sa interface
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa3	Enter sa Interface mode
(config-if)#port-channel min-bandwidth 30g	Configure min-bandwidth value on sa/po interface

TOR2

#configure terminal	Enter configure mode.
bridge 1 protocol rstp vlan-bridge end	Configure bridge type
configure terminal	Enter Configure mode.
(config)# vlan database	Enter vlan database
(config-vlan)# vlan 600 bridge 1 state enable	Configure vlans
#configure terminal	Enter Configure mode.
(config)#interface mlag1	Enter Interface mode
(config-if)# switchport	Make mlag as layer2 port
(config-if)# bridge-group 1	Attach interface to bridge
(config-if)# switchport mode trunk	Configure trunk port
(config-if)# switchport trunk allowed vlan add 600,601,502	Add interface to vlans
(config-if)# spanning-tree edgeport	Configure port as edge port to avoid loops
(config-if)# spanning-tree bpdu-filter enable	Enable bpdu filter to avoid loops
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface mlag3	Enter Interface mode
(config-if)# switchport	Make mlag as layer2 port
(config-if)# bridge-group 1	Attach interface to bridge
(config-if)# switchport mode trunk	Configure trunk port
(config-if)# switchport trunk allowed vlan add 600,502	Add interface to vlans
(config-if)# spanning-tree edgeport	Configure port as edge port to avoid loops
(config-if)# spanning-tree bpdu-filter enable	Enable bpdu filter to avoid loops
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface po100	Enter Interface mode
(config-if)# switchport	Make po(IDL) as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)# port-channel load-balance src-dst-mac	Enable load balance
(config-if)# mtu 9216	Configure mtu
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa1	Enter Interface mode
(config-if)# switchport	Make sa1 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.

(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed all	Enable all VLAN identifiers on this interface.
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa3	Enter Interface mode
(config-if)# switchport	Make sa3 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed all	Enable all VLAN identifiers on this interface.
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce1/1	Enter Interface mode
(config-if)#port breakout enable	Port breakout enabled
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce1/2	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce1/3	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/1	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/2	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/3	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce3/4	Enter Interface mode
(config-if)# channel-group 100 mode active	Add interface to po100
(config-if)#end	Return to privilege mode

#configure terminal	Enter Configure mode.
(config)#interface ce5/1	Enter Interface mode
(config-if)#port breakout enable	Port breakout enabled
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce5/2	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface ce5/3	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#mcec domain configuration	Enter Multichasis Etherchannel domain configuration mode.
(config-mcec-domain)# domain-address 1111.2222.3333	Configure the domain address.
(config-mcec-domain)# domain-system-number 2	Configure the domain system number
(config-mcec-domain)# intra-domain-link po100	Specify the intra domain link for MLAG communication
(config-mcec-domain)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#int mlag1	Enter Interface mode
(config-if)#mode active-standby	Configure mlag mode for mlag1
(config-if)#switchover type revertive 10	Configure revertive timer
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa1	Enter Interface mode
(config-if)#mlag 1	Map sa1 to mlag1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#int mlag3	Enter Interface mode
(config-if)#mode active-standby	Configure mlag mode for mlag3
(config-if)#switchover type revertive 10	Configure revertive timer
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface sa3	Enter Interface mode
(config-if)#mlag 3	Map sa3 to mlag3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config-if)# interface sa1	Enter sa interface mode
(config-if)#port-channel min-links 3	Configure min-link value on sa interface

(config)#interface sa3	Enter sa Interface mode
(config-if)#port-channel min-bandwidth 30g	Configure min-bandwidth value on sa interface.

SW1

configure terminal	Enter Configure mode.
bridge 1 protocol rstp vlan-bridge	Configure bridge type
(config)#vlan database	Create vlan database
(config-vlan)#vlan 600,601,502,101,100 bridge 1 state enable	Create Vlans
(config-vlan)#end	Return to privilege mode
configure terminal	Enter Configure mode.
(config)#interface xe1	Enter Interface mode
(config-if)# switchport	Make xe1 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#spanning-tree edgeport	Configure port as edgeport
(config-if)#spanning-tree bpdu-filter enable	Enable spanning tree bpdu filter
(config-if)# mtu 9216	Configure mtu
(config-if)#end	Return to privilege mode
configure terminal	Enter Configure mode.
(config)#interface sa1	Enter Interface mode
(config-if)# switchport	Make xe1 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan add 100,101,300,401,402	Enable all VLAN identifiers on this interface.
(config-if)#spanning-tree edgeport	Configure port as edgeport
(config-if)#spanning-tree bpdu-filter enable	Enable spanning tree bpdu filter
(config-if)# mtu 9216	Configure mtu
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe2	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe3	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.

(config)#interface xe4	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa1
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe6	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe7	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe8	Enter Interface mode
(config-if)# static-channel-group 1	Add interface to sa3
(config-if)#end	Return to privilege mode

SW2

configure terminal	Enter Configure mode.
bridge 1 protocol rstp vlan-bridge	Configure bridge type
(config)#vlan database	Create vlan database
(config-vlan)#vlan 600,601,502,101,100 bridge 1 state enable	Create vlans
(config-vlan)#end	Return to privilege mode
configure terminal	Enter Configure mode.
(config)#interface xe5/1	Enter Interface mode
(config-if)# switchport	Make xe1 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#spanning-tree edgeport	Configure port as edge port
(config-if)#spanning-tree bpdu-filter enable	Enable spanning tree bpdu filter
(config-if)# mtu 9216	Configure mtu
(config-if)#end	Return to privilege mode
configure terminal	Enter Configure mode.
(config)#interface sa3	Enter Interface mode
(config-if)# switchport	Make sa3 as layer2 port
(config-if)# bridge-group 1	Associate the interface with bridge group 1.
(config-if)# switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)# switchport trunk allowed vlan add 100,101,401,402,600,502	Enable all VLAN identifiers on this interface.

(config-if)#spanning-tree edgeport	Configure port as edge port
(config-if)#spanning-tree bpdu-filter enable	Enable spanning tree bpdu filter
(config-if)# mtu 9216	Configure mtu
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe3/1	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe3/2	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe3/3	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe1/1	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe1/2	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode
#configure terminal	Enter Configure mode.
(config)#interface xe1/3	Enter Interface mode
(config-if)# static-channel-group 3	Add interface to sa3
(config-if)#end	Return to privilege mode

This configuration is applicable for the dynamic LAG with MC-LAG topology except dynamic LAG interface creations, which needs to be referred from the dynamic LAG configurations given above.

Validation Commands

sh int brief sa [id], sh int brief po [id], sh mlag-domain summary, sh static-channel-group <sa id>, <sh etherchannel>, sh running-config interface sa [id], <sh etherchannel summary>.

When sa or po goes down due to min-link or min-bandwidth not satisfied, below validations to be done:

SW2

```
#sh int brief sa1
Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
```

```
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down

-------------------------------------------------------------------------------
Port-channel Type  PVID  Mode              Status   Reason  Speed
Interface
-------------------------------------------------------------------------------
--
sa1           AGG   1     trunk             down     PD(Min L/B)  0

#
#sh int brief po100

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down,
 IA - InActive
       PD(Min L/B) - Protocol Down Min-Links/Bandwidth
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
       HD  - ESI Hold Timer Down


-------------------------------------------------------------------------------
--
Port-channel  Type  PVID  Mode              Status   Reason  Speed
Interface
-------------------------------------------------------------------------------
--
po100         AGG   1     trunk             down     PD(Min L/B)  0

#
#sh etherchannel
% Lacp Aggregator: po100
% Min-Bandwidth : 40g
% Protocol Down (Min L/B) : True
% Member:
   ce3/1
   ce3/2
   ce3/3
   ce3/4
-------------------------------------
% Lacp Aggregator: po200
% Member:
   ce29/1
   ce29/2
-------------------------------------
% Lacp Aggregator: sa1
% Min-links : 3
```

```
% Protocol Down (Min L/B): True
% Member:
   ce2/2
   ce2/3
   ce2/4
-------------------------------------
% Lacp Aggregator: sa3
% Member:
   ce4/1
   ce4/2
   ce4/3
#
#sh running-config interface sa1
!
interface sa1
 switchport
 port-channel load-balance src-dst-mac
 port-channel min-links 3
 mlag 1
!

#sh static-channel-group 1
 Static Aggregator: sa1
 Minimum-Links 3
 Member Status
  ce2/2          down
  ce2/3          down
  ce2/4          down
#
#sh etherchannel summary
  Aggregator po100 100100
  Aggregator Type: Layer2
  Admin Key: 0100 - Oper Key 0100
     Link: ce3/1 (5057) sync: 0
     Link: ce3/2 (5058) sync: 0
     Link: ce3/3 (5059) sync: 0
     Link: ce3/4 (5060) sync: 0
-------------------------------------
```

LACP Force-Up

In an aggregated environment, there are some parameters that are set for member ports in lag. Whenever the parameters are set and conditions are satisfied, the port channel will be in SYNC. If force-up mode is enabled for the member port, the port channel will always be in SYNC even if the parameters are not set i.e. the traffic will not be affected and the port channel will never go down.

LACP force-up with Dynamic LAG

Topology

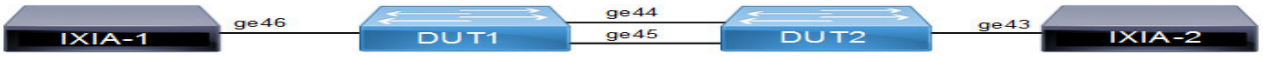


Figure 8-14: LACP force-up with Dynamic LAG

CE1

`#configure terminal`	Enter configure mode.
`(config)#hostname CE1`	Configure host name
`(config)#bridge 1 protocol rstp vlan-bridge`	Create a RSTP VLAN bridge on customer side
`(config)#vlan 2-100 bridge 1 state enable`	Configure VLAN for the bridge
`(config)#interface ge46`	Enter interface mode
`(config-if)#switchport`	Make interface as Switchport
`(config-if)#bridge-group 1`	Associate the interface to bridge
`(config-if)#switchport mode hybrid`	Configure the mode as hybrid
`(config-if)#switchport hybrid allowed vlan all`	Configure allowed VLAN all on the interface
`(config-if)#load-interval 30`	Configure load period in multiple of 30 seconds
`(config)#interface po1`	Enter the interface mode
`(config-if)#switchport`	Make the interface as switch port
`(config-if)#bridge-group 1`	Associate the interface to bridge
`(config-if)#switchport mode hybrid`	Configure the mode as hybrid
`(config-if)#switchport hybrid allowed vlan all`	Configure allowed vlan all for the hybrid mode
`(config-if)#load-interval 30`	Configure load period in multiple of 30 seconds
`(config)#interface ge44`	Enter interface mode
`(config-if)#channel-group 1 mode active`	Adding interface to channel-group 1
`(config)#interface ge45`	Enter interface mode
`(config-if)#channel-group 1 mode active`	Adding interface to channel-group 1

CE2

`#configure terminal`	Enter configure mode.
`(config)#hostname CE2`	Configure host name
`(config)#bridge 1 protocol provider-rstp edge`	Create provider rstp edge bridge
`(config)#vlan database`	Enter vlan database mode
`(config-vlan)#vlan 2-100 type customer bridge 1 state enable`	Configure customer VLAN for the bridge
`(config-vlan)#vlan 100 type service point-point bridge 1 state enable`	Configure service VLAN for the bridge

(config)#exit	Exit vlan database mode
(config)#cvlan registration table map1 bridge 1	Creating registration table
(config)#cvlan 2-100 svlan 100	Mapping cvlan to svlan
(config)#interface ge43	Enter interface mode
(config-if)#switchport	Make interface as Switchport
(config-if)#bridge-group 1	Associate the interface to bridge
(config-if)#switchport mode provider-network	Configure the mode as provider-network
(config-if)# switchport provider-network allowed vlan all	Configure allowed VLAN all on the interface
(config-if)#load-interval 30	Configure load period in multiple of 30 seconds
(config)#interface po1	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1	Associate the interface with bridge group 1
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer-edge hybrid
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer-edge hybrid and allow vlan all
(config-if)#switchport customer-edge vlan registration map1	Configuring the registration table mapping on lag interface
(config-if)#load-interval 30	Configure load period in multiple of 30 seconds
(config)#interface ge44	Enter interface mode
(config-if)#channel-group 1 mode active	Adding interface to channel-group 1
(config-if)#lacp force-up	Enable lacp force-up for the member port interface
(config)#interface ge45	Enter interface mode
(config-if)#channel-group 1 mode active	Adding interface to channel-group 1

Send L2 traffic with incremental source mac of 1000 and with VLAN 100 from CE1 and with incremental source mac of 1000 and with SVLAN 100(TPID 0x88a8), CVLAN 100 from CE2.

Validation

CE1

```
CE1#show mac address-table count bridge 1
MAC Entries for all vlans:
Dynamic Address Count: 2001
Static (User-defined) Unicast MAC Address Count: 0
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 2001

CE1#show etherchannel summary
  Aggregator po1 100001
  Aggregator Type: Layer2
  Admin Key: 0001 - Oper Key 0001
     Link: ge44 (5043) sync: 1
```

```
     Link: ge45 (5046) sync: 1

CE1#show interface counters rate mbps
+------------------+-------------+------------+-------------+------------+
|     Interface    |    Rx mbps  |    Rx pps  |    Tx mbps  |    Tx pps  |
+------------------+-------------+------------+-------------+------------+
 ge44                363.65        710252       772.76        1420506
 ge45                363.63        710222       0.00          0
 ge46                772.77        1420525      727.31        1420526
 po1                 728.56        1422971      774.09        1422966

CE2#show mac address-table count bridge 1
MAC Entries for all vlans:
Dynamic Address Count: 2001
Static (User-defined) Unicast MAC Address Count: 0
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 2001

CE2#show interface counters rate mbps
+------------------+-------------+------------+-------------+------------+
|     Interface    |    Rx mbps  |    Rx pps  |    Tx mbps  |    Tx pps  |
+------------------+-------------+------------+-------------+------------+
 ge43                774.26        1423267      784.17        1361411
 ge44                774.26        1423268      364.36        711634
 ge45                0.00          0            364.36        711634
 po1                 774.26        1423267      728.71        1423267

CE2#show etherchannel summary
  Aggregator po1 100001
  Aggregator Type: Layer2
  Admin Key: 0001 - Oper Key 0001
     Link: ge44 (5020) sync: 1
     Link: ge45 (5022) sync: 1

On server side (PE1) to make LAG down you can unconfigure the channel-group 1
configurations and verify force-up is getting enabled in PE2.
To simulate the force-up
```

`PE1(config)#interface ge44`	Enter interface mode.
`PE1(config-if)#no channel-group`	Removing channel-group configurations from interface.
`PE1(config)#interface ge45`	Enter interface mode.
`PE1(config-if)#no channel-group`	Removing channel-group configurations from interface.

PE2

```
PE2#show interface brief | include po1
po1           AGG   1     customer-edge     up       none    1g

PE2#show etherchannel summary
  Aggregator po1 100001
  Aggregator Type: Layer2
```

```
  Admin Key: 0001 - Oper Key 0001
     Link: ge44 (5020) sync: 0 (force-up)
     Link: ge45 (5022) sync: 0

PE2#show etherchannel detail
 Aggregator po1 100001
 Aggregator Type: Layer2
  Mac address: b8:6a:97:4d:65:d5
  Admin Key: 0001 - Oper Key 0001
   Actor LAG ID- 0x8000,b8-6a-97-28-a5-c0,0x0001
   Receive link count: 0 - Transmit link count: 0
   Individual: 0 - Ready: 1
  Partner LAG ID- 0x0000,00-00-00-00-00-00,0x0000
    Link: ge44 (5020) sync: 0 (force-up)
    Link: ge45 (5022) sync: 0
  Collector max delay: 5

To forward traffic from ge44 of PE1
```

`PE1(config)#interface ge44`	Enter interface mode.
`PE1(config-if)#switchport`	Make the interface as switch port.
`PE1(config-if)#bridge-group 1`	Associate the interface to bridge.
`PE1(config-if)#switchport mode hybrid`	Configure the mode as hybrid.
`PE1(config-if)#switchport hybrid allowed vlan all`	Configure allowed vlan all for the hybrid mode.
`PE1(config-if)#load-interval 30`	Configure load period in multiple of 30 seconds.

```
PE2#show interface counters rate mbps
+------------------+--------------+-------------+--------------+-------------+
|     Interface    |    Rx mbps   |    Rx pps   |    Tx mbps   |    Tx pps   |
+------------------+--------------+-------------+--------------+-------------+
 ge43                774.25         1423257       784.17         1361400
 ge44                774.25         1423258       728.71         1423257
 ge45                0.00           0             0.00           0
 po1                 774.25         1423247       728.70         1423245
 CE2#
PE1#show interface counters rate mbps
+------------------+--------------+-------------+--------------+-------------+
|     Interface    |    Rx mbps   |    Rx pps   |    Tx mbps   |    Tx pps   |
+------------------+--------------+-------------+--------------+-------------+
 ge44                657.67         1284505       640.77         1177884
 ge45                0.00           0             0.00           0
 ge46                772.71         1420426       603.08         1177886
```

CHAPTER 9 MLAG Configuration

This chapter contains a complete example of Multi-Chassis Link Aggregation (MLAG) configuration.

MLAG (also called DRNI, Distributed Resilient Network Interconnect) expands the concept of link aggregation so that it provides node-level redundancy by allowing two or more nodes to share a common LAG endpoint. MLAG emulates multiple nodes to represent as a single logical node to the remote node running link aggregation. As a result even if one of the nodes is down there exists a path to reach the destination through the other nodes.

Note: MLAG is compatible only with a RSTP VLAN-aware bridge or a spanning tree disabled bridge.

Note: All MLAG nodes must have the same MAC table size as specified by each node's switching ASIC forwarding profile limit.

Note: More than one IDL is not supported in single node under mcec configuration.

Dynamic Configuration

Topology

As shown in Figure 9-15, switches 3 and 4 form an MLAG domain. Switches 3 and 4 are a single logical switch to switches 1 and 2. Even if either switch 3 or 4 is down, there exists a path to reach other destinations.

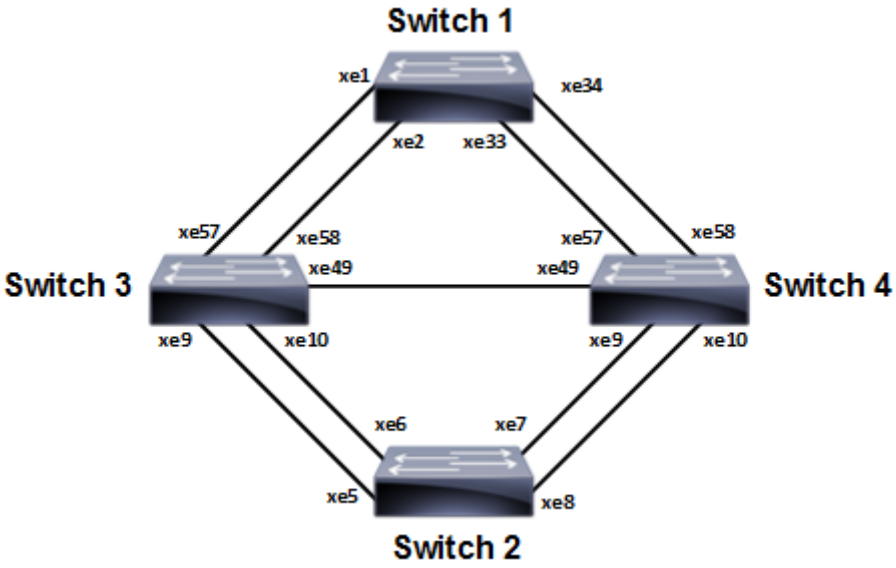


Figure 9-15: MLAG Topology

Switch 1

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol rstp vlan-bridge`	Create RSTP bridge 1.
`(config)#vlan 2 bridge 1 state enable`	Create VLAN 2.
`(config)#interface po2`	Enter interface mode.
`(config-if)#switchport`	Configure the interface as Layer 2

(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#exit	Exit interface mode.
(config)#interface xe1	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe2	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe33	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe34	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.

Switch 2

#configure terminal	Enter configure mode.
(config)#bridge 1 protocol rstp vlan-bridge	Create RSTP bridge 1.
(config)#vlan 2 bridge 1 state enable	Create VLAN 2.
(config)#interface po1	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#exit	Exit interface mode.
(config)#interface xe5	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe6	Enter interface mode.

(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe7	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe8	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.

Switch 3

#configure terminal	Enter configure mode.
(config)#bridge 1 protocol rstp vlan-bridge	Create RSTP bridge 1.
(config)#vlan 2 bridge 1 state enable	Create VLAN 2.
(config)#interface mlag1	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#exit	Exit interface mode.
(config)#interface mlag2	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#exit	Exit interface mode.
(config)#interface po1	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#mlag 1	Enabling Mlag group number
(config-if)#exit	Exit interface mode.
(config)#interface po2	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#mlag 2	enabling Mlag group number
(config-if)#exit	Exit interface mode.
(config)#interface xe9	Enter interface mode.

(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe57	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe58	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe10	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#mcec domain configuration	Entering MCEC mode
(config-mcec-domain)#domain-address 1111.2222.3333	Domain address for the mlag domain
(config-mcec-domain)#intra-domain link xe49	Intra domain line between mlag domain
(config-mcec-domain)#domain-system-number 1	Number to identify the node in a domain
(config-mcec-domain)#exit	Exit MCEC mode

Switch 4

#configure terminal	Enter configure mode.
(config)#bridge 1 protocol rstp vlan-bridge	Create RSTP bridge 1.
(config)#vlan 2 bridge 1 state enable	Create VLAN 2.
(config)#interface mlag1	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.
(config-if)#exit	Exit interface mode.
(config)#interface mlag2	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode trunk	Set the switching characteristics of this interface to trunk mode.
(config-if)#switchport trunk allowed vlan all	Enable all VLAN identifiers on this interface.

(config-if)#exit	Exit interface mode.
(config)#interface po1	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#mlag 1	Enabling Mlag group number
(config-if)#exit	Exit interface mode.
(config)#interface po2	Enter interface mode.
(config-if)#switchport	Configure the interface as Layer 2
(config-if)#mlag 2	enabling Mlag group number
(config-if)#exit	Exit interface mode.
(config)#interface xe9	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe10	Enter interface mode.
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe57	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#interface xe58	Enter interface mode.
(config-if)#channel-group 2 mode active	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode.
(config)#mcec domain configuration	Entering MCEC mode
(config-mcec-domain)#domain-address 1111.2222.3333	Domain address for the Mlag domain
(config-mcec-domain)#intra-domain link xe49	Intra domain Link between Mlag domains
(config-mcec-domain)#domain-system-number 2	Number to identify the node in domain
(config-mcec-domain)#exit	Exit MCEC mode

Validation

Switch 3

```
#sh mlag domain details

-----------------------------------
Domain Configuration
-----------------------------------
```

```
Domain System Number           : 1
Domain Address                 : 1111.2222.3333
Domain Priority                : 1000
Intra Domain Interface         : xe49

Hello RCV State                : Current
Hello Periodic Timer State     : Fast Periodic
Domain Sync                    : IN_SYNC
Neigh Domain Sync              : IN_SYNC
Domain Adjacency               : UP

-----------------------------------
MLAG Configuration
-----------------------------------

MLAG-1
  Mapped Aggregator            : po1
  Admin Key                    : 16385
  Oper Key                     : 16385
  Physical properties Digest   : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82

  Neigh Admin Key              : 32769
  Neigh Physical Digest        : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Mlag Sync                    : IN_SYNC
  Mode                         : Active

MLAG-2
  Mapped Aggregator            : po2
  Admin Key                    : 16386
  Oper Key                     : 16386
  Physical properties Digest   : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82

  Neigh Admin Key              : 32770
  Neigh Physical Digest        : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Mlag Sync                    : IN_SYNC
  Mode                         : Active

#sh etherchannel summary
% Aggregator po1 0
% Aggregator Type: Layer2
% Admin Key: 16385 - Oper Key 16385
%   Link: xe57 (5057) sync: 1
%   Link: xe58 (5058) sync: 1
% Aggregator po2 0
% Aggregator Type: Layer2
```

```
% Admin Key: 16386 - Oper Key 16386
%   Link: xe9 (5009) sync: 1
%   Link: xe10 (5010) sync: 1

#sh mlag 1 detail

MLAG-1
  Mapped Aggregator           : po1
  Admin Key                   : 16385
  Oper Key                    : 16385
  Physical properties Digest  : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82

  Neigh Admin Key             : 32769
  Neigh Physical Digest       : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
  Info RCV State              : Current
  Info Periodic Time State    : Standby
  Total Bandwidth             : 20g
  Mlag Sync                   : IN_SYNC
  Mode                        : Active

sh mcec statistics

Unknown MCCPDU received on the system            : 0

-------------------------------------
IDP xe49
-------------------------------------
   Valid RX Hello PDUs                          : 398
   Valid TX Hello PDUs                          : 417
   Valid RX Info PDUs                           : 16
   Valid TX Info PDUs                           : 6

   Valid RX Mac Sync PDUs                       : 3
   Valid TX Mac Sync PDUs                       : 4

MLAG 1
  Valid RX Info PDUs                            : 8
  Valid TX Info PDUs                            : 3

MLAG 2
  Valid RX Info PDUs                            : 8
  Valid TX Info PDUs                            : 3
sh mlag domain summary

-------------------------------------
Domain Configuration
-------------------------------------

Domain System Number            : 1
Domain Address                  : 1111.2222.3333
```

```
Domain Priority                 : 1000
Intra Domain Interface          : xe49
Domain Adjacency                : UP

-----------------------------------
MLAG Configuration
-----------------------------------

MLAG-1
  Mapped Aggregator             : po1
  Physical properties Digest    : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active

MLAG-2
  Mapped Aggregator             : po2
  Physical properties Digest    : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active
```

Static Configuration

Static MLAG provides node-level redundancy by allowing two or more nodes in the network to share a common static-LAG endpoint. It emulates multiple nodes to represent as a single logical node to the remote node having static Link aggregation. As a result, even if one of the nodes is down there exists a path to reach the destination via other nodes.

Topology

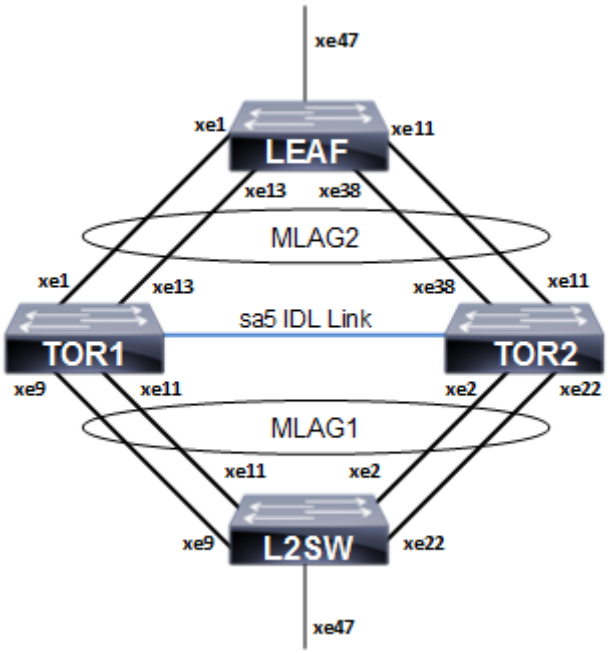


Figure 9-16: Static MLAG topology

L2SW

`#configure terminal`	Enter configure mode.
`(config)#hostname L2SW`	Configuring host name
`(config)#bridge 1 protocol rstp vlan-bridge`	Create a RSTP VLAN bridge on customer side
`(config)#vlan 2 bridge 1 state enable`	Configure VLAN for the bridge
`(config)#interface sa1`	Enter the interface mode
`(config-if)#bridge-group 1 spanning-tree disable`	Disable the spanning-tree for the interface
`(config-if)#switchport mode hybrid`	Configure the mode as hybrid
`(config-if)#switchport hybrid allowed vlan all`	Configure allowed VLAN all on the interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface xe2`	Enter the interface mode
`(config-if)#static-channel-group 1`	Map static channel to the interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface xe9`	Enter the interface mode

(config-if)#static-channel-group 1	Map static channel to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe11	Enter the interface mode
(config-if)#static-channel-group 1	Map static channel to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe22	Enter the interface mode
(config-if)#static-channel-group 1	Map static channel to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe47	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1 spanning-tree disable	Disable the spanning-tree for the interface
(config-if)#switchport mode hybrid	Configure the mode as hybrid
(config-if)#switchport hybrid allowed vlan all	Configure allowed VLAN all on the interface
(config-if)#exit	Exit the interface mode

TOR1

#configure terminal	Enter configure mode.
(config)#hostname TOR1	Configuring host name
(config)#bridge 1 protocol provider-rstp edge	Create a PROVIDER-RSTP EDGE bridge
(config)#vlan 2 bridge 1 state enable	Configure VLAN for the bridge
(config)#vlan 200 type service point-point bridge 1 state enable	Configure SVLAN for the bridge
(config)#cvlan registration table map1 bridge 1	Configure cvlan-svlan mapping registration table for the bridge
(config-cvlan-registration)#cvlan 2 svlan 200	Map CVLAN to SVLAN
(config-cvlan-registration)#exit	Exit the config-cvlan-registration mode
(config)#interface mlag1	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1	Associate the interface to bridge
(config-if)#switchport mode customer-edge hybrid	Configure the mode as customer-edge hybrid
(config-if)#switchport customer-edge hybrid allowed vlan all	Configure allowed VLAN all on the interface
(config-if)#switchport customer-edge vlan registration map1	Map the cvlan registration table into the MLAG interface
(config-if)#exit	Exit the interface mode
(config)#interface mlag2	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1	Associate the interface to bridge
(config-if)#switchport mode provider-network	Configure the mode as provider-network

(config-if)#switchport provider-network allowed vlan all	Configure allowed VLAN all on the interface
(config)#interface sa1	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#mlag 1	Map MLAG on SA interface
(config-if)#exit	Exit the interface mode
(config)#interface sa2	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#mlag 2	Map MLAG on SA interface
(config-if)#exit	Exit the interface mode
(config)#interface xe1	Enter the interface mode
(config-if)#static-channel-group 2	Map static channel-group to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe13	Enter the interface mode
(config-if)#static-channel-group 2	Map static channel-group to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe9	Enter the interface mode
(config-if)#static-channel-group 1	Map static channel-group to the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe11	Enter the interface mode
(config-if)#static-channel-group 1	Map static channel to the interface
(config-if)#exit	Exit the interface mode
(config)#interface sa5	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1	Associate the interface to bridge
(config-if)#switchport mode provider-network	Configure the mode as provider network
(config-if)#switchport provider-network allowed vlan all	Configure allowed VLAN all on the interface
(config)#interface xe3	Enter the interface mode
(config-if)#static-channel-group 5	Map static channel-group to the interface
(config)#interface xe5	Enter the interface mode
(config-if)#static-channel-group 5	Map static channel-group to the interface
(config-if)#exit	Exit the interface mode
(config)#mcec domain configuration	Enter the MLAG domain configuration mode
(config-mcec-domain)#domain-address 1111.2222.3333	Configure the MLAG domain address
(config-mcec-domain)#domain-system-number 1	Configure MLAG domain system number
(config-mcec-domain)#intra-domain-link sa5	Configure the intra domain link

TOR2

`#configure terminal`	Enter configure mode.
`(config)#hostname TOR2`	Configuring host name
`(config)#bridge 1 protocol provider-rstp edge`	Create a PROVIDER-RSTP EDGE bridge
`(config)#vlan 2 bridge 1 state enable`	Configure VLAN for the bridge
`(config)#vlan 200 type service point-point bridge 1 state enable`	Configure SVLAN for the bridge
`(config)#cvlan registration table map1 bridge 1`	Configure cvlan-svlan mapping registration table for the bridge
`(config-cvlan-registration)#cvlan 2 svlan 200`	Map CVLAN to SVLAN
`(config-cvlan-registration)#exit`	Exit the config-cvlan-registration mode
`(config)#interface mlag1`	Enter the interface mode
`(config-if)#switchport`	Make the interface as switch port
`(config-if)#bridge-group 1`	Associate the interface to bridge
`(config-if)#switchport mode customer-edge hybrid`	Configure the mode as customer-edge hybrid
`(config-if)#switchport customer-edge hybrid allowed vlan all`	Configure allowed VLAN all on the interface
`(config-if)#switchport customer-edge vlan registration map1`	Map the cvlan registration table into the MLAG interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface mlag2`	Enter the interface mode
`(config-if)#switchport`	Make the interface as switch port
`(config-if)#bridge-group 1`	Associate the interface to bridge
`(config-if)#switchport mode provider-network`	Configure the mode as provider-network
`(config-if)#switchport provider-network allowed vlan all`	Configure allowed VLAN all on the interface
`(config)#interface sa1`	Enter the interface mode
`(config-if)#switchport`	Make the interface as switch port
`(config-if)#mlag 1`	Map MLAG on SA interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface sa2`	Enter the interface mode
`(config-if)#switchport`	Make the interface as switch port
`(config-if)#mlag 2`	Map MLAG on SA interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface xe11`	Enter the interface mode
`(config-if)#static-channel-group 2`	Map static channel to the interface
`(config-if)#exit`	Exit the interface mode
`(config)#interface xe38`	Enter the interface mode
`(config-if)#static-channel-group 2`	Map static channel to the interface
`(config-if)#exit`	Exit the interface mode

(config)#interface xe2	Enter the interface mode
(config-if)#static-channel-group 1	Create static channel group
(config-if)#exit	Exit the interface mode
(config)#interface xe22	Enter the interface mode
(config-if)#static-channel-group 1	Create static channel group
(config-if)#exit	Exit the interface mode
(config)#interface sa5	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1	Associate the interface to bridge
(config-if)#switchport mode provider-network	Configure the mode as provider network
(config-if)#switchport provider-network allowed vlan all	Configure allowed VLAN all on the interface
(config)#interface xe3	Enter the interface mode
(config-if)#static-channel-group 5	Map static channel-group to the interface
(config)#interface xe5	Enter the interface mode
(config-if)#static-channel-group 5	Map static channel-group to the interface
(config-if)#exit	Exit the interface mode
(config)#mcec domain configuration	Enter the MLAG domain configuration mode
(config-mcec-domain)#domain-address 1111.2222.3333	Configure the MLAG domain address
(config-mcec-domain)#domain-system-number 2	Configure MLAG domain system number
(config-mcec-domain)#intra-domain-link sa5	Configure the intera domain link
(config-if)#exit	Exit the interface mode

LEAF

#configure terminal	Enter configure mode.
(config)#hostname LEAF	Configuring host name
(config)#bridge 1 protocol provider-rstp edge	Create a PROVIDER-RSTP EDGE bridge
(config)#vlan 2 bridge 1 state enable	Configure VLAN for the bridge
(config)#vlan 200 type service point-point bridge 1 state enable	Configure SVLAN for the bridge
(config)#cvlan registration table map1 bridge 1	Configure cvlan-svlan mapping registration table for the bridge
(config-cvlan-registration)#cvlan 2 svlan 200	Map CVLAN to SVLAN
(config-cvlan-registration)#exit	Exit the config-cvlan-registration mode
(config)#interface sa2	Enter the interface mode
(config-if)#swtichport	Make the interface a switch port
(config-if)#bridge-group 1 spanning-tree disable	Disable the spanning-tree for the interface
(config-if)#switchport mode provider-network	Configure the mode as provider-network

(config-if)#)#switchport provider-network allowed vlan all	Configure allowed VLAN all on the interface
(config-if)#exit	Exit the interface mode
(config)#interface xe1	Enter the interface mode
(config-if)#static-channel-group 2	Map the interface to the static channel-group
(config-if)#exit	Exit the interface mode
(config)#interface xe13	Enter the interface mode
(config-if)#static-channel-group 2	Create static channel group
(config-if)#exit	Exit the interface mode
(config)#interface xe11	Enter the interface mode
(config-if)#static-channel-group 2	Map the interface to the static channel-group
(config-if)#exit	Exit the interface mode
(config)#interface xe38	Enter the interface mode
(config-if)#static-channel-group 2	Create static channel group
(config-if)#exit	Exit the interface mode
(config)#interface xe47	Enter the interface mode
(config-if)#switchport	Make the interface as switch port
(config-if)#bridge-group 1 spanning-tree disable	Disable the spanning-tree for the interface
(config-if)#switchport mode customer-edge hybrid	Configure the mode as customer-edge hybrid
(config-if)#switchport customer-edge hybrid allowed vlan all	Configure allowed VLAN all on the interface
(config-if)#switchport customer-edge vlan registration map1	Map the cvlan registration table into the MLAG interface
(config-if)#exit	Exit the interface mode

Validation

```
TOR1#show mlag 1 detail

MLAG-1
  Mapped Aggregator            : sa1
  Admin Key                    : 16385
  Oper Key                     : 16385
  Physical properties Digest   : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57 cc

  Neigh Admin Key              : 32769
  Neigh Physical Digest        : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57 cc
  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Total Bandwidth              : 40g
  Mlag Sync                    : IN_SYNC
  Mode                         : Active
TOR1#
```

```
TOR1#show mlag domain summary

-----------------------------------
Domain Configuration
-----------------------------------

Domain System Number            : 1
Domain Address                  : 1111.2222.3333
Domain Priority                 : 32768
Intra Domain Interface          : sa5
Domain Adjacency                : UP

-----------------------------------
MLAG Configuration
-----------------------------------

MLAG-1
  Mapped Aggregator             : sa1
  Physical properties Digest    : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57 cc
  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active


MLAG-2
  Mapped Aggregator             : sa2
  Physical properties Digest    : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5 c8

  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active


TOR1#
TOR1#show mlag domain detail

-----------------------------------
Domain Configuration
-----------------------------------

Domain System Number            : 1
Domain Address                  : 1111.2222.3333
Domain Priority                 : 32768
Intra Domain Interface          : sa5

Hello RCV State                 : Current
Hello Periodic Timer State      : Slow Periodic
Domain Sync                     : IN_SYNC
Neigh Domain Sync               : IN_SYNC
Domain Adjacency                : UP
```

```
-----------------------------------
MLAG Configuration
-----------------------------------

MLAG-1
  Mapped Aggregator            : sa1
  Admin Key                    : 16385
  Oper Key                     : 16385
  Physical properties Digest   : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57 cc

  Neigh Admin Key              : 32769
  Neigh Physical Digest        : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57 cc
  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Total Bandwidth              : 40g
  Mlag Sync                    : IN_SYNC
  Mode                         : Active

MLAG-2
  Mapped Aggregator            : sa2
  Admin Key                    : 16386
  Oper Key                     : 16386
  Physical properties Digest   : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5 c8


  Neigh Admin Key              : 32770
  Neigh Physical Digest        : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5 c8

  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Total Bandwidth              : 40g
  Mlag Sync                    : IN_SYNC
  Mode                         : Active

TOR1#
```

ARP ACL Configuration

Topology

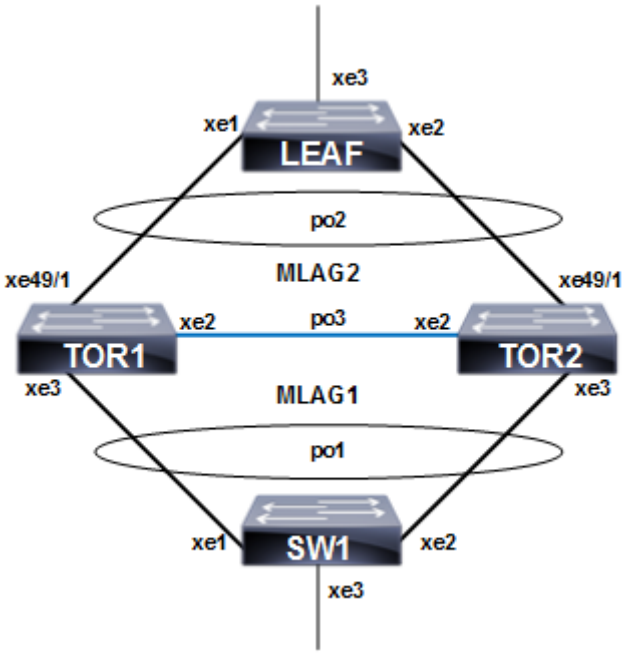


Figure 9-17: ARP ACL configuration with MC LAG

TOR1

`TOR1(config)#bridge 1 protocol provider-rstp edge`	Create provider rstp bridge
`TOR1(config)#vlan 2-3990 type customer bridge 1 state enable`	Enable customer vlan for bridge
`TOR1(config)#vlan 2-3990 type service point-point bridge 1 state enable`	Enable service vlan for bridge
`TOR1(config)#cvlan registration table map1 bridge 1`	Create registration table
`TOR1(config-cvlan-registration)#cvlan 2-3990 svlan 3990`	Map cvlan to svlan
`TOR1(config-cvlan-registration)#exit`	Exit the cvlan registration table mode
`TOR1(config-if)#interface mlag1`	Enter mlag interface
`TOR1(config-if)#switchport`	Configure interface as switchport
`TOR1(config-if)#bridge-group 1 spanning-tree disable`	Associate the interface with bridge group 1and disabling spanning-tree
`TOR1(config-if)#switchport mode customer-edge hybrid`	Set the switching characteristics of this interface to customer-edge hybrid
`TOR1(config-if)#switchport customer-edge hybrid allowed vlan all`	Set the switching characteristics of this interface to customer-edge hybrid and allow vlan all

`TOR1(config-if)#switchport customer-edge vlan registration map1`	Configure the registration table mapping on mlag interface
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config)#interface mlag2`	Enter mlag interface
`TOR1(config-if)#switchport`	Configure interface as switchport
`TOR1(config-if)#bridge-group 1`	Associate the interface with bridge group 1
`TOR1(config-if)#switchport mode provider-network`	Set the switching characteristics of this interface to provider network
`TOR1(config-if)#switchport provider-network allowed vlan all`	Set the switching characteristics of this interface to provider network and allow all vlan
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config)#interface po1`	Enter dynamic lag interface
`TOR1(config-if)#switchport`	Configure interface as switchport
`TOR1(config-if)#mlag 1`	Enable mlag group number
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config-if)#interface po2`	Enter dynamic lag interface
`TOR1(config-if)#switchport`	Configure interface as switchport
`TOR1(config-if)#mlag 2`	Enable mlag group number
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config)#interface po3`	Enter dynamic lag interface
`TOR1(config-if)#switchport`	Configure interface as switchport
`TOR1(config-if)#bridge-group 1`	Associate the interface with bridge group 1
`TOR1(config-if)#switchport mode provider-network`	Set the switching characteristics of this interface to provider network
`TOR1(config-if)#switchport provider-network allowed vlan all`	Set the switching characteristics of this interface to provider network and allow all vlan
`TOR1(config)#interface xe2`	Enter interface mode
`TOR1(config-if)#channel-group 3 mode active`	Make part of channel group 3
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config)#interface xe3`	Enter interface mode
`TOR1(config-if)#channel-group 1 mode active`	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config-if)#interface xe49/1`	Enter interface mode
`TOR1(config-if)#channel-group 2 mode active`	Enable channel-group 2
`TOR1(config-if)#exit`	Exit the interface mode
`TOR1(config)#mcec domain configuration`	Enter MCEC mode
`TOR1(config-mcec-domain)#domain-address 2222.3333.4444`	Domain address for the mlag domain
`TOR1(config-mcec-domain)#domain-system-number 1`	Number to identify the node in a domain
`TOR1(config-mcec-domain)#intra-domain-link po3`	Intra domain line between mlag domain

TOR1(config)#hardware-profile filter ingress-arp enable	Enable globally hardware profile for arp
TOR1(config)#arp access-list cep	Create access list with name as cep
TOR1(config-arp-acl)#30 permit request ip any mac host 0000.2A6C.668D vlan 3990 inner-vlan 2	Create permit rule for particular arp request
TOR1(config-arp-acl)#40 permit response ip any any mac host 0000.2A6C.668D host 0000.2A6C.7202 vlan 3990 inner-vlan 2	Create permit rule for particular arp response
TOR1(config)#arp access-list pnp	Create access list with name as pnp
TOR1(config-arp-acl)#20 permit request ip any mac host 0000.2A6C.7202 vlan 3990 inner-vlan 2	Create permit rule for particular arp request
TOR1(config-arp-acl)#30 permit response ip any any mac host 0000.2A6C.7202 host 0000.2A6C.668D vlan 3990 inner-vlan 2	Create permit rule for particular arp response
TOR1(config-if)#interface mlag1	Enter mlag1 interface
TOR1(config-if)#arp access-group cep in	Attach rule with access-group cep
TOR1(config-if)#interface mlag2	Enter mlag2 interface
TOR1(config-if)#arp access-group pnp in	Attach rule with access-group pnp

TOR2

TOR2(config)#bridge 1 protocol provider-rstp edge	Create provider rstp bridge
TOR2(config)#vlan 2-3990 type customer bridge 1 state enable	Enable customer vlan for bridge
TOR2(config)#vlan 2-3990 type service point-point bridge 1 state enable	Enable service vlan for bridge
TOR2(config)#cvlan registration table map1 bridge 1	Create registration table
TOR2(config-cvlan-registration)#cvlan 2-3990 svlan 3990	Map cvlan to svlan
TOR2(config-cvlan-registration)#exit	Exit the cvlan registration table mode
TOR2(config)#interface mlag1	Enter mlag interface
TOR2(config-if)#switchport	Configure interface as switchport
TOR2(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
TOR2(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer-edge hybrid
TOR2(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer-edge hybrid and allow vlan all
TOR2(config-if)#switchport customer-edge vlan registration map1	Configure the registration table mapping on mlag interface
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#interface mlag2	Enter mlag interface
TOR2(config-if)#switchport	Configure interface as switchport
TOR2(config-if)#bridge-group 1	Associate the interface with bridge group 1

TOR2(config-if)#switchport mode provider-network	Set the switching characteristics of this interface to provider network
TOR2(config-if)#switchport provider-network allowed vlan all	Set the switching characteristics of this interface to provider network and allow all vlan
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#interface po1	Enter dynamic lag interface
TOR2(config-if)#switchport	Configure interface as switchport
TOR2(config-if)#mlag 1	Enable mlag group number
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#interface po2	Enter dynamic lag interface
TOR2(config-if)#switchport	Configure interface as switchport
TOR2(config-if)#mlag 2	Enable mlag group number
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#interface po3	Enter dynamic lag interface
TOR2(config-if)#switchport	Configure interface as switchport
TOR2(config-if)#bridge-group 1	Associate the interface with bridge group 1
TOR2(config-if)#switchport mode provider-network	Set the switching characteristics of this interface to provider network
TOR2(config-if)#switchport provider-network allowed vlan all	Set the switching characteristics of this interface to provider network and allow all vlan
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#interface xe2	Enter interface mode
TOR2(config-if)#channel-group 3 mode active	Make part of channel group 3
TOR2(config-if)#interface xe3	Enter interface mode
TOR2(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system
TOR2(config-if)#exit	Exit the interface mode
TOR2(config)#Interface xe49/1	Enter interface mode
TOR2(config-if)#channel-group 2 mode active	Enable channel-group 2
TOR2(config)#mcec domain configuration	Configure mcec domain information
TOR2(config-mcec-domain)#domain-address 2222.3333.4444	Domain address for the mlag domain
TOR2(config-mcec-domain)#domain-system-number 2	Number to identify the node in a domain
TOR2(config-mcec-domain)#intra-domain-link po3	Intra domain line between mlag domain
TOR2(config)#hardware-profile filter ingress-arp enable	Enable globally hardware profile for arp
TOR2(config)#arp access-list cep	Create access list with name as cep
TOR2(config-arp-acl)#30 permit request ip any mac host 0000.2A6C.668D vlan 3990 inner-vlan 2	Create permit rule for particular arp request
TOR2(config-arp-acl)#40 permit response ip any any mac host 0000.2A6C.668D host 0000.2A6C.7202 vlan 3990 inner-vlan 2	Create permit rule for particular arp response

TOR2(config)#arp access-list pnp	Create access list with name as pnp
TOR2(config-arp-acl)#20 permit request ip any mac host 0000.2A6C.7202 vlan 3990 inner-vlan 2	Create permit rule for particular arp request
TOR2(config-arp-acl)#30 permit response ip any any mac host 0000.2A6C.7202 host 0000.2A6C.668D vlan 3990 inner-vlan 2	Create permit rule for particular arp response
TOR2(config-if)#interface mlag1	Enter mlag1 interface
TOR2(config-if)#arp access-group cep in	Attach rule with access-group cep
TOR2(config-if)#interface mlag2	Enter mlag2 interface
TOR2(config-if)#arp access-group pnp in	Attach rule with access-group pnp

SW1

SW1(config)#bridge 1 protocol rstp vlan-bridge	Configure the rstp vlan bridge
SW1(config)#vlan 2-3990 type customer bridge 1 state enable	Enable customer vlan for bridge
SW1(config-if)#interface po1	Enter dynamic lag interface
SW1(config-if)#switchport	Configure interface as switchport
SW1(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
SW1(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
SW1(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all vlan
SW1(config-if)#exit	Exit the interface mode
SW1(config)#interface xe1	Enter interface mode
SW1(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
SW1(config-if)#exit	Exit the interface mode
SW1(config)#interface xe2	Enter interface mode
SW1(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
SW1(config-if)#exit	Exit the interface mode
SW1(config)#interface xe3	Enter interface mode
SW1(config-if)#switchport	Configure interface as switchport
SW1(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
SW1(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
SW1(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all vlan
SW1(config-if)#exit	Exit the interface mode

LEAF

`Leaf(config)#bridge 1 protocol provider-rstp edge`	Configure the rstp vlan bridge
`Leaf(config)#vlan 2-3990 type customer bridge 1 state enable`	Enable customer vlan for bridge
`Leaf(config)#vlan 2-3990 type service point-point bridge 1 state enable`	Enable service vlan for bridge
`Leaf(config)#cvlan registration table map1 bridge 1`	Create registration table
`Leaf(config-cvlan-registration)#cvlan 2-3990 svlan 3990`	Map cvlan to svlan
`Leaf(config-if)#exit`	Exit the cvlan registration table mode
`Leaf(config)#interface po2`	Enter interface mode
`Leaf(config-if)#switchport`	Configure interface as switchport
`Leaf(config-if)#bridge-group 1 spanning-tree disable`	Associate the interface with bridge group 1and disabling spanning-tree
`Leaf(config-if)#switchport mode provider-network`	Set the switching characteristics of this interface provider network
`Leaf(config-if)#switchport provider-network allowed vlan all`	Set the switching characteristics of this interface provider and allowing all vlan
`Leaf(config-if)#exit`	Exit the interface mode
`Leaf(config)#interface xe1`	Enter interface mode
`Leaf(config-if)#channel-group 2 mode active`	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
`Leaf(config-if)#exit`	Exit the interface mode
`Leaf(config)#interface xe2`	Enter interface mode
`Leaf(config-if)#channel-group 2 mode active`	Add this interface to channel group 2 and enable link aggregation so that it can be selected for aggregation by the local system.
`Leaf(config-if)#exit`	Exit the interface mode
`Leaf(config)#Interface xe3`	Enter interface mode
`Leaf(config-if)#switchport`	Configure interface as switchport
`Leaf(config-if)#bridge-group 1 spanning-tree disable`	Associate the interface with bridge group 1and disabling spanning-tree
`Leaf(config-if)#switchport mode customer-edge hybrid`	Set the switching characteristics of this interface to customer-edge hybrid
`Leaf(config-if)#switchport customer-edge hybrid allowed vlan all`	Set the switching characteristics of this interface to customer-edge hybrid and allow vlan all
`Leaf(config-if)#switchport customer-edge vlan registration map1`	Configure the registration table mapping on mlag interface
`Leaf(config-if)#exit`	Exit the interface mode

Validation

```
TOR1#show access-lists
ARP access list cep
```

```
        30 permit request ip any mac host 0000.2A6C.668D vlan 3990 inner-vlan 2
        40 permit response ip any any mac host 0000.2A6C.668D host 0000.2A6C.7202 vlan
3990 inner-vlan 2
        default deny-all
ARP access list pnp
       20 permit request ip any mac host 0000.2A6C.7202 vlan 3990 inner-vlan 2 [match=1]
        30 permit response ip any any mac host 0000.2A6C.7202 host 0000.2A6C.668D vlan
3990 inner-vlan 2 [match=1]
        default deny-all log

TOR2#show access-lists
ARP access list cep
       30 permit request ip any mac host 0000.2A6C.668D vlan 3990 inner-vlan 2 [match=1]
        40 permit response ip any any mac host 0000.2A6C.668D host 0000.2A6C.7202 vlan
3990 inner-vlan 2 [match=1]
        default deny-all log
ARP access list pnp
        20 permit request ip any mac host 0000.2A6C.7202 vlan 3990 inner-vlan 2
        30 permit response ip any any mac host 0000.2A6C.7202 host 0000.2A6C.668D vlan
3990 inner-vlan 2
        default deny-all
```

Disabling STP for MLAG

The command `no bridge 1 provider-rstp enable bridge-forward` is used to disable the spanning tree globally.

Enabling Provider RSTP

`OcNOS#configure terminal`	Enter Configure mode.
`OcNOS(config)#bridge 1 protocol provider-rstp edge`	Configure Provider-rstp edge bridge.
`OcNOS(config)#interface xe13/2`	Configure interface xe13/2\
`OcNOS(config-if)#switchport`	Configure the interface as switchport
`OcNOS(config-if)#bridge-group 1`	Assign the above created bridge to this port.
`OcNOS(config-vrf)#exit`	Exit from interface mode to config mode
`OcNOS(config)#interface po1`	Configure interface po1
`OcNOS(config-if)#switchport`	Configure the interface as switchport
`OcNOS(config-if)#bridge-group 1`	Assign the above created bridge to this port.
`OcNOS(config-vrf)#exit`	Exit from interface mode to config mode
`OcNOS(config)#interface mlag2`	Configure interface mlag1
`OcNOS(config-if)#switchport`	Configure the interface as switchport
`OcNOS(config-if)#bridge-group 1 spanning-tree disable`	Assign the above created bridge to this port and disable the spanning tree.
`OcNOS(config-vrf)#exit`	Exit from interface mode to config mode

Validation

```
OcNOS#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8000ecf4bbfc6928
% 1: Bridge Id 8000ecf4bbfc6928
% 1: last topology change Tue Jul 30 06:47:37 2019
% 1: 2 topology change(s)  - last topology change Tue Jul 30 06:47:37 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
%   xe13/2: Port Number 942 - Ifindex 5038 - Port Id 0x83ae - Role Designated - State
Forwarding
%   xe13/2: Designated Path Cost 0
%   xe13/2: Configured Path Cost 2000  - Add type Explicit ref count 1
%   xe13/2: Designated Port Id 0x83ae - Priority 128  -
%   xe13/2: Root 8000ecf4bbfc6928
%   xe13/2: Designated Bridge 8000ecf4bbfc6928
%   xe13/2: Message Age 0 - Max Age 20
%   xe13/2: Hello Time 2 - Forward Delay 15
%   xe13/2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   xe13/2: forward-transitions 3
%   xe13/2: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   xe13/2: No portfast configured - Current  portfast off
%   xe13/2: bpdu-guard  default  - Current bpdu-guard off
%   xe13/2: bpdu-filter default  - Current bpdu-filter off
%   xe13/2: no root guard configured     - Current root guard off
%   xe13/2: Configured Link Type point-to-point - Current point-to-point
%   xe13/2: No auto-edge configured - Current port Auto Edge off
%
%   po1: Port Number 1697 - Ifindex 100001 - Port Id 0x86a1 - Role Designated - State
Forwarding
%   po1: Designated Path Cost 0
%   po1: Configured Path Cost 2000  - Add type Explicit ref count 1
%   po1: Designated Port Id 0x86a1 - Priority 128  -
%   po1: Root 8000ecf4bbfc6928
%   po1: Designated Bridge 8000ecf4bbfc6928
%   po1: Message Age 0 - Max Age 20
%   po1: Hello Time 2 - Forward Delay 15
%   po1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   po1: forward-transitions 1
%   po1: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   po1: No portfast configured - Current  portfast off
%   po1: bpdu-guard  default  - Current bpdu-guard off
%   po1: bpdu-filter default  - Current bpdu-filter off
%   po1: no root guard configured     - Current root guard off
%   po1: Configured Link Type point-to-point - Current point-to-point
%   po1: No auto-edge configured - Current port Auto Edge off
%
```

```
%   mlag2: Port Number 2690 - Ifindex 400002 - Port Id 0x8a82 - Role Disabled - State
Forwarding
%   mlag2: Designated Path Cost 0
%   mlag2: Configured Path Cost 20000000  - Add type Explicit ref count 1
%   mlag2: Designated Port Id 0x0 - Priority 128  -
%   mlag2: Message Age 0 - Max Age 0
%   mlag2: Hello Time 0 - Forward Delay 0
%   mlag2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   mlag2: forward-transitions 1
%   mlag2: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   mlag2: No portfast configured - Current  portfast off
%   mlag2: bpdu-guard  default  - Current bpdu-guard off
%   mlag2: bpdu-filter default  - Current bpdu-filter off
%   mlag2: no root guard configured     - Current root guard off
%   mlag2: Configured Link Type point-to-point - Current point-to-point
%   mlag2: No auto-edge configured - Current port Auto Edge off
%
```

Disabling RSTP Globally

`OcNOS#configure terminal`	Enter Configure mode.
`OcNOS(config)#no bridge 1 provider-rstp enable bridge-forward`	Disable spanning tree globally for Provider-RSTP and keeping the ports in Forwarding state.
`OcNOS(config)#interface mlag1`	Configure interface mlag1
`OcNOS(config-if)#switchport`	Configure the interface as switchport
`OcNOS(config-if)#bridge-group 1`	Assign the above created bridge to this port.
`OcNOS(config-vrf)#exit`	Exit from interface mode to config mode

Validation

```
OcNOS#sh run int mlag2
!
interface mlag2
 switchport
 bridge-group 1 spanning-tree disable
 switchport mode provider-network
!
OcNOS#sh run int mlag1
!
interface mlag1
 switchport
 bridge-group 1
 switchport mode provider-network
!
OcNOS#
OcNOS#sh spanning-tree
% 1: Bridge up - Spanning Tree Disabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
```

```
% 1: Root Id 8000000000000000
% 1: Bridge Id 8000000000000000
% 1: 2 topology change(s)  - last topology change Tue Jul 30 06:47:37 2019

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
%   xe13/2: Port Number 942 - Ifindex 5038 - Port Id 0x83ae - Role Disabled - State
Forwarding
%   xe13/2: Designated Path Cost 0
%   xe13/2: Configured Path Cost 2000  - Add type Explicit ref count 1
%   xe13/2: Designated Port Id 0x83ae - Priority 128  -
%   xe13/2: Message Age 0 - Max Age 20
%   xe13/2: Hello Time 2 - Forward Delay 15
%   xe13/2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   xe13/2: forward-transitions 4
%   xe13/2: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   xe13/2: No portfast configured - Current  portfast off
%   xe13/2: bpdu-guard  default  - Current bpdu-guard off
%   xe13/2: bpdu-filter default  - Current bpdu-filter off
%   xe13/2: no root guard configured     - Current root guard off
%   xe13/2: Configured Link Type point-to-point - Current point-to-point
%   xe13/2: No auto-edge configured - Current port Auto Edge off
%
%   po1: Port Number 1697 - Ifindex 100001 - Port Id 0x86a1 - Role Disabled - State
Forwarding
%   po1: Designated Path Cost 0
%   po1: Configured Path Cost 2000  - Add type Explicit ref count 1
%   po1: Designated Port Id 0x86a1 - Priority 128  -
%   po1: Message Age 0 - Max Age 20
%   po1: Hello Time 2 - Forward Delay 15
%   po1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   po1: forward-transitions 2
%   po1: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   po1: No portfast configured - Current  portfast off
%   po1: bpdu-guard  default  - Current bpdu-guard off
%   po1: bpdu-filter default  - Current bpdu-filter off
%   po1: no root guard configured     - Current root guard off
%   po1: Configured Link Type point-to-point - Current point-to-point
%   po1: No auto-edge configured - Current port Auto Edge off
%
%   mlag1: Port Number 2689 - Ifindex 400001 - Port Id 0x8a81 - Role Disabled - State
Forwarding
%   mlag1: Designated Path Cost 0
%   mlag1: Configured Path Cost 20000000  - Add type Explicit ref count 1
%   mlag1: Designated Port Id 0x0 - Priority 128  -
%   mlag1: Message Age 0 - Max Age 0
%   mlag1: Hello Time 0 - Forward Delay 0
%   mlag1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   mlag1: forward-transitions 2
%   mlag1: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   mlag1: No portfast configured - Current  portfast off
```

```
%   mlag1: bpdu-guard  default  - Current bpdu-guard off
%   mlag1: bpdu-filter default  - Current bpdu-filter off
%   mlag1: no root guard configured     - Current root guard off
%   mlag1: Configured Link Type point-to-point - Current point-to-point
%   mlag1: No auto-edge configured - Current port Auto Edge off
%
%   mlag2: Port Number 2690 - Ifindex 400002 - Port Id 0x8a82 - Role Disabled - State
Forwarding
%   mlag2: Designated Path Cost 0
%   mlag2: Configured Path Cost 20000000  - Add type Explicit ref count 1
%   mlag2: Designated Port Id 0x0 - Priority 128  -
%   mlag2: Message Age 0 - Max Age 0
%   mlag2: Hello Time 0 - Forward Delay 0
%   mlag2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0 - topo change timer 0
%   mlag2: forward-transitions 2
%   mlag2: Version Rapid Spanning Tree Protocol - Receive None - Send RSTP
%   mlag2: No portfast configured - Current  portfast off
%   mlag2: bpdu-guard  default  - Current bpdu-guard off
%   mlag2: bpdu-filter default  - Current bpdu-filter off
%   mlag2: no root guard configured     - Current root guard off
%   mlag2: Configured Link Type point-to-point - Current point-to-point
%   mlag2: No auto-edge configured - Current port Auto Edge off
%
```

CHAPTER 10 802.1X Configuration

IEEE 802.1x restricts unauthenticated devices from connecting to a switch. Only after authentication is successful, traffic is allowed through the switch.

Topology

In this example, a radius server keeps the client information, validating the identity of the client and updating the switch about the authentication status of the client. The switch is the physical access between the two clients and the server. It requests information from the client, relays information to the server and then back to the client. To configure 802.1x authentication, enable authentication on ports eth1 and eth2 and specify the radius server IP address and port.

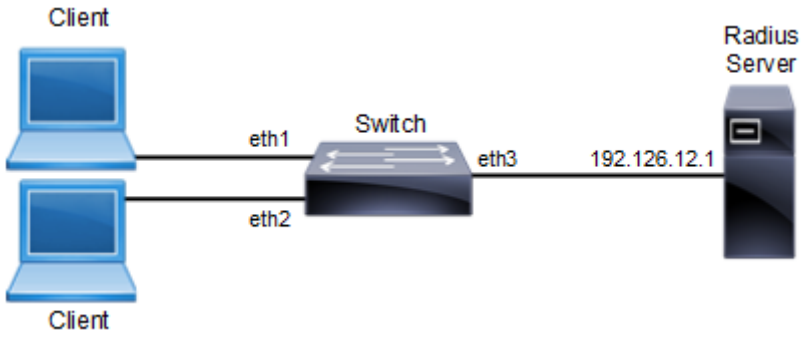


Figure 10-18: 802.1x Topology

Switch Configuration

`Switch#configure terminal`	Enter configure mode.
`Switch(config)#port-security disable`	Disable the port-security.
`Switch(config)#dot1x system-auth-ctrl`	Enable authentication globally.
`Switch(config)#interface eth2`	Enter interface mode.
`Switch(config-if)#switchport`	Enable switch port on interface.
`Switch(config-if)#dot1x port-control auto`	Enable authentication (via Radius) on port (`eth2`).
`Switch(config-if)#exit`	Exit interface mode.
`Switch(config)#interface eth1`	Enter interface mode.
`Switch(config-if)#switchport`	Enable switch port on interface.
`Switch(config-if)#dot1x port-control auto`	Enable authentication (via Radius) on port (`eth1`).
`Switch(config-if)#exit`	Exit interface mode.
`Switch(config)#radius-server dot1x key-string testing123`	Specify key with string name between radius server and client
`Switch(config)#radius-server dot1x host 192.126.12.1`	Specify the Radius Server address (192.126.12.1)
`Switch(config-radius-server)#exit`	Exit from radius server mode.
`Switch(config)#interface eth3`	Enter interface mode.
`Switch(config-if)#ip address 192.126.12.2/24`	Set the IP address on interface `eth3`.
`Switch(config-if)#commit`	Commit the transaction.
`Switch(config-if)#exit`	Exit interface mode.

Validation

```
#show dot1x all
802.1X Port-Based Authentication Enabled
  RADIUS server address: 192.168.1.1:60000
  Next radius message id: 147
  RADIUS client address: not configured


802.1X info for interface eth1
  portEnabled: true - portControl: Auto
  portStatus: Unauthorized - currentId: 29
  protocol version: 2
  reAuthenticate: disabled
  reAuthPeriod: 3600
  abort:F fail:F start:F timeout:F success:F
  PAE: state: Connecting - portMode: Auto
  PAE: reAuthCount: 1 - rxRespId: 0
  PAE: quietPeriod: 60 - reauthMax: 2 - txPeriod: 30
  BE: state: Idle - reqCount: 0 - idFromServer: 0
  BE: suppTimeout: 30 - serverTimeout: 30
  CD: adminControlledDirections: in - operControlledDirections: in
  CD: bridgeDetected: false
  KR: rxKey: false
  KT: keyAvailable: false - keyTxEnabled: false

802.1X info for interface eth2
  portEnabled: true - portControl: Auto
  portStatus: Unauthorized - currentId: 29
  protocol version: 2
  reAuthenticate: disabled
  reAuthPeriod: 3600
  abort:F fail:F start:F timeout:F success:F
  PAE: state: Connecting - portMode: Auto
  PAE: reAuthCount: 1 - rxRespId: 0
  PAE: quietPeriod: 60 - reauthMax: 2 - txPeriod: 30
  BE: state: Idle - reqCount: 0 - idFromServer: 0
  BE: suppTimeout: 30 - serverTimeout: 30
  CD: adminControlledDirections: in - operControlledDirections: in
  CD: bridgeDetected: false
  KR: rxKey: false
  KT: keyAvailable: false - keyTxEnabled: false

#show dot1x
802.1X Port-Based Authentication Enabled
  RADIUS server address: 192.168.1.1:60000
  Next radius message id: 147
  RADIUS client address: not configured
```

CHAPTER 11 Port Security Configuration

The Port Security feature allows network administrators to block unauthorized access to the network. Network administrators can configure each port of the switch to allow network access from only secured MACs, so that the switch forwards traffic from only secured MACs.

Users can limit each port's ingress traffic by limiting MAC addresses (source MACs) that are used to send traffic into ports. Port Security enables users to configure the maximum number of secured MACs for each port. Switches learn secured MAC dynamically (learned by switch during traffic inflow) or statically (User configured MACs). Dynamically Learned or statically programmed MAC addresses cannot exceed the maximum number of secured MACs configured for a particular port. Once the switch reaches the maximum limit for secured MACs, traffic from all other MAC addresses are dropped.

The violated MACs are logged in syslog messages. Refer to `cpu queue portsec-drop` using the command `show interface cpu counter queue-stats` for information on the number of violated MACs.

Secured MACs Learned Dynamically

Figure 11-19: Secured MACs learned dynamically

Send Layer-2 traffic with incremental source MAC of 100 and with VLAN 100 from IXIA1 and since max limit is configured as 3 – only 3 secure MAC addresses will be learned by SW1.

SW1

`#configure terminal`	Enter configure mode.
`(config)#hostname SW1`	Set the host name
`(config)#bridge 1 protocol rstp vlan-bridge`	Create a RSTP VLAN bridge on customer side
`(config)#vlan 2-200 bridge 1 state enable`	Configure VLAN for the bridge
`(config)#interface ge1`	Enter interface mode
`(config-if)#switchport`	Make the interface Layer 2
`(config-if)#bridge-group 1`	Associate the interface to bridge
`(config-if)#switchport mode hybrid`	Configure the mode as trunk
`(config-if)#switchport hybrid allowed vlan all`	Configure allowed VLAN all on the interface
`(config-if)#switchport port-security`	Enable port security mode dynamic
`(config-if)#switchport port-security maximum 3`	Limit secure MAC to 3 mac addresses.
`(config-if)#exit`	Exit interface mode
`(config)#interface ge2`	Enter interface mode
`(config-if)#switchport`	Make the interface Layer 2
`(config-if)#bridge-group 1`	Associate the interface to bridge

`(config-if)#switchport mode hybrid`	Configure the mode as trunk
`(config-if)#switchport hybrid allowed vlan all`	Configure allowed VLAN all on the interface
`(config-if)#exit`	Exit interface mode
`(config)#logging monitor 7`	Enable logging level as 7 for debugging

Validation

Validation commands are "`show port-security`," "`show port-security interface <ifname>`," "`show mac address-table count bridge 1`," "`show bridge`," and "`show mac address-table bridge 1`."

```
SW1#show port-security
Port    port-security mode  MAC limit CVLAN  SVLAN  static secure MAC
-------+-------------------+---------+------+------+-----------------
ge1     dynamic             3

SW1#show port-security interface ge1
Port Security Mode     : Dynamic
Secure MAC limit       : 3
Static Secure MAC list :
CVLAN  SVLAN  MAC Address
------+------+----------------

SW1#show mac address-table count bridge 1
MAC Entries for all vlans:
Dynamic Address Count: 3
Static (User-defined) Unicast MAC Address Count: 0
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 3

SW1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         100                 ge1         0000.0300.0500    1     100
 1         100                 ge1         0000.0300.055b    1     100
 1         100                 ge1         0000.0300.055c    1     100

SW1#show mac address-table bridge 1
 VLAN   MAC Address     Type      Ports     Port-security
------+---------------+---------+---------+--------------
 100   0000.0300.0500   dynamic   ge1       Enable
 100   0000.0300.055b   dynamic   ge1       Enable
 100   0000.0300.055c   dynamic   ge1       Enable
SW1#
```

Secured MAC Addresses Learned Statically

1. Stop the traffic from IXIA1 and do "`clear mac address-table dynamic bridge 1`" on SW1.
2. Verify all dynamic secured MAC addresses are cleared.
3. Configure 3 static secure MAC addresses using the commands below in port security configured interface.
4. Try to add a fourth static secure MAC address.
5. Verify operator log message is displayed, saying "`port security mac limit reached`."

`(config)#interface ge1`	Enter interface mode
`(config-if)#switchport port-security mac-address 0000.0000.aaaa vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode
`(config-if)#switchport port-security mac-address 0000.0000.aaab vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode
`(config-if)#switchport port-security mac-address 0000.0000.aaac vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode

Validation

```
SW1#show port-security
Port    port-security mode  MAC limit CVLAN  SVLAN  static secure MAC
-------+-------------------+---------+------+------+-----------------
ge1     dynamic             3         100          0000.0000.aaaa
                                      100          0000.0000.aaab
                                      100          0000.0000.aaac

SW1#show port-security interface ge1
Port Security Mode     : Dynamic
Secure MAC limit       : 3
Static Secure MAC list :
CVLAN  SVLAN  MAC Address
------+------+----------------
 100          0000.0000.aaaa
 100          0000.0000.aaab
 100          0000.0000.aaac

SW1#show mac address-table count bridge 1
MAC Entries for all vlans:
Dynamic Address Count: 0
Static (User-defined) Unicast MAC Address Count: 3
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 3

SW1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
```

```
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         100                  ge1         0000.0000.aaaa    1     -
 1         100                  ge1         0000.0000.aaab    1     -
 1         100                  ge1         0000.0000.aaac    1     -

SW1#show mac address-table bridge 1
 VLAN   MAC Address     Type      Ports     Port-security
------+---------------+---------+---------+--------------
 100   0000.0000.aaaa   static    ge1       Enable
 100   0000.0000.aaab   static    ge1       Enable
 100   0000.0000.aaac   static    ge1       Enable
SW1#
```

Remove the port-security configuration method using the two commands below:

(

`config)#interface ge1`	Enter interface mode
`(config-if)#no switchport port-security`	Set the port-security method to static.

Static Mode

Use the below command to configure the port-security method to static and configure static secure MAC addresses using the commands the in static port-security method, below.

`(config)#interface ge1`	Enter interface mode
`(config-if)#switchport port-security static`	Set the port-security method as static.
`(config-if)#switchport port-security max 3`	Limit static secure MAC to 3 mac addresses.
`(config-if)#switchport port-security mac-address 0000.0000.aaaa vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode.
`(config-if)#switchport port-security mac-address 0000.0000.aaab vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode.
`(config-if)#switchport port-security mac-address 0000.0000.aaac vlanId 100`	Add static secure MAC address for VLAN 100 in interface mode .

Verify the 3 secure static MAC addresses are added in interface ge1 using show running-config and also verify the port-security method should be static using below show commands.

Validation

```
SW1#show running-config interface ge1
interface ge1
 switchport
bridge-group 1
  switchport mode hybrid
 switchport hybrid allowed vlan all
 switchport port-security static
 switchport port-security maximum 3
 switchport port-security mac-address 0000.0000.aaaa vlanId 100
 switchport port-security mac-address 0000.0000.aaab vlanId 100
 switchport port-security mac-address 0000.0000.aaac vlanId 100
```



```
SW1#show port-security
Port    port-security mode  MAC limit CVLAN  SVLAN  static secure MAC
------+------------------+---------+------+------+-----------------
ge1     static              3        100          0000.0000.aaaa
                                        100          0000.0000.aaab
                                       100          0000.0000.aaac

SW1#show port-security interface ge1
Port Security Mode     : Static
Secure MAC limit       : 3
Static Secure MAC list :
CVLAN  SVLAN  MAC Address
------+------+----------------
 100          0000.0000.aaaa
 100          0000.0000.aaab
 100          0000.0000.aaac

SW1#show mac address-table count bridge 1
MAC Entries for all vlans:
Dynamic Address Count: 0
Static (User-defined) Unicast MAC Address Count: 3
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 3

SW1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         100                  ge1         0000.0000.aaaa    1     -
 1         100                  ge1         0000.0000.aaab    1     -
 1         100                  ge1         0000.0000.aaac    1     -

 SW1#show mac address-table bridge 1
 VLAN   MAC Address     Type      Ports     Port-security
------+--------------+--------+---------+-------------
 100   0000.0000.aaaa   static    ge1       Enable
 100   0000.0000.aaab   static    ge1       Enable
 100   0000.0000.aaac   static    ge1       Enable
SW1#
```

Configure one more static secure MAC address on interface ge1 and try to verify "`port security mac limit reached`" operator log message is displayed.

Start sending Layer-2 traffic with incremental source MAC of 100 and with VLAN 100 from IXIA1, and verify no dynamic secure MAC addresses are being learned using all the validation commands used.

Port Security using MC-LAG

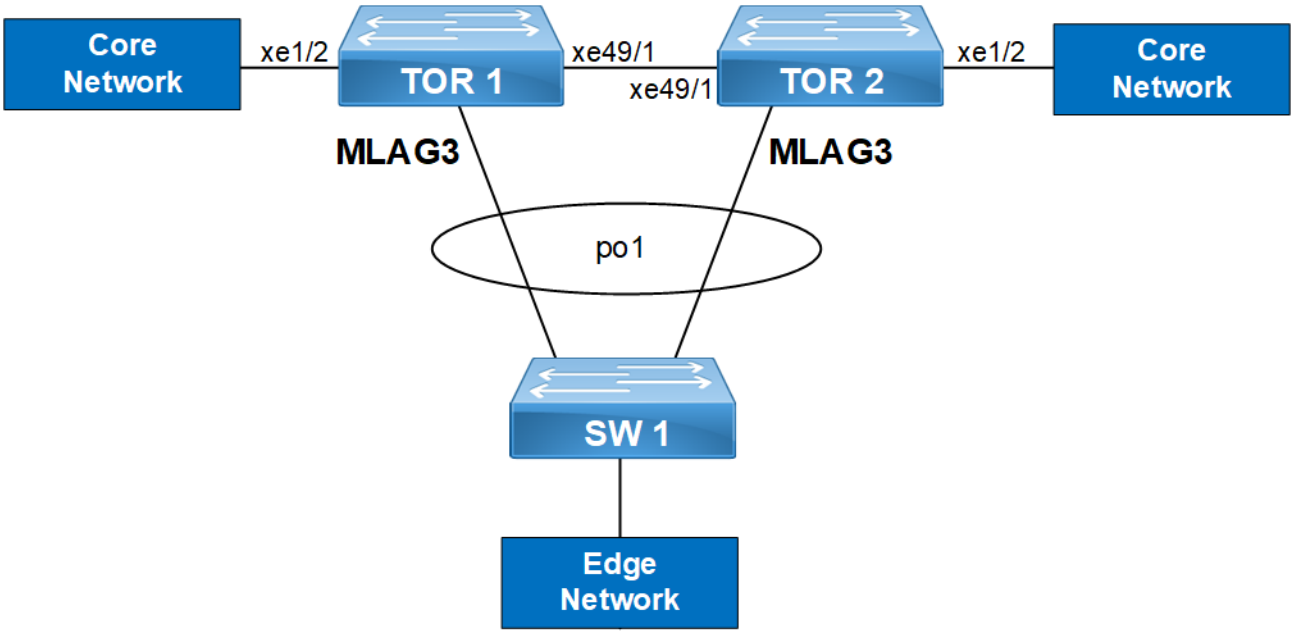


Figure 11-20: Port security with MC-LAG

TOR1

`#configgure termonal`	Enter configure mode
`(config)#bridge 1 protocol provider-rstp edge`	Create provider RSTP bridge
`(config)#vlan 2-10 type customer bridge 1 state enable`	Enabling customer vlan for bridge
`(config)#vlan 2-10 type service point-point bridge 1 state enable`	Enabling service vlan for bridge
`(config)#cvlan registration table map1 bridge 1`	Creating registration table
`(config-cvlan-registation)#cvlan 2 svlan 2`	Mapping CVLAN to SVLAN
`(config-cvlan-registation)#cvlan 10 svlan 2`	Mapping CVLAN to SVLAN
`(config-cvlan-registation)#exit`	Exit registration table mode
`(config)#interface mlag3`	Entering MLAG interface
`(config-if)#switchport`	Configuring interface as switchport
`(config-if)#exit`	Exit interface mode
`(config)#interface po1`	Entering dynamic lag interface
`(config-if)#switchport`	Configuring interface as switchport
`(config-if)#bridge-group 1 spanning-tree disable`	Associate the interface with bridge group 1and disabling spanning-tree
`(config-if)#switchport mode customer-edge hybrid`	Set the switching characteristics of this interface to customer edge hybrid

(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN 2
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#mlag 3	Enabling mlag group number
(config-if)#exit	Exit interface mode
(config)#interface xe49/1	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode provider-network	Set the switching characteristics of this interface to provider network
(config-if)#switchport provider-network allowed vlan all	Set the switching characteristics of this interface to provider network and allow all VLAN
(config-if)#exit	Enter interface mode
(config)#interface xe3	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer edge hybrid
(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow vlan 2
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system
(config-if)#exit	Exit interface mode
(config)#interface mlag3	Entering MLAG interface
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer edge hybrid
(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN 2
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#switchport customer-edge vlan registration map1	Configuring the registration table mapping on MLAG interface
(config-if)#switchport port-security	Enabling port security
(config-if)#switchport port-security maximum 10	Limiting the maximum mac to 10
(config-if)#exit	Exit interface mode
(config)#mcec domain configuration	Entering MCEC mode
(config-mcec-domain)#domain-address 2222.2222.2222	Domain address for the MLAG domain
(config-mcec-domain)#domain-system-number 1	Number to identify the node in a domain
(config-mcec-domain)#exit	Exit MCEC mode

(config)#intra-domain-link xe49/1	Intra domain line between MLAG domain
(config-if)#domain-priority 333	Domain priority for MCEC

TOR2

(config-if)#

#configure terminal	Enter configure mode
(config)#bridge 1 protocol provider-rstp edge	Create provider RSTP bridge
(config)#vlan 2-10 type customer bridge 1 state enable	Enabling customer VLAN for bridge
(config)#vlan 2-10 type service point-point bridge 1 state enable	Enabling service VLAN for bridge
(config)#cvlan registration table map1 bridge 1	Creating registration table
(config-cvlan-registation)#cvlan 2 svlan 2	Mapping CVLAN to SVLAN
(config-cvlan-registation)#cvlan 10 svlan 2	Mapping CVLAN to SVLAN
(config-cvlan-registation)#exit	Exit registration table mode
(config)#interface mlag3	Entering MLAG interface
(config-if)#switchport	Configuring interface as switchport
(config-if)#exit	Exit interface mode
(config)#interface po1	Entering dynamic lag interface
(config-if)#Switchport	Configuring interface as switchport
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer edge hybrid
(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN 2
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#mlag 3	Enabling MLAG group number
(config-if)#exit	Exit interface mode
(config)#interface xe49/1	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1	Associate the interface with bridge group 1.
(config-if)#switchport mode provider-network	Set the switching characteristics of this interface to provider network
(config-if)#switchport provider-network allowed vlan all	Set the switching characteristics of this interface to provider network and allow all VLAN
(config-if)#exit	Exit interface mode
(config)#interface xe3	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
bridge-group 1	Associate the interface with bridge group 1
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer edge hybrid

(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN 2
(config-if)#switchport customer-edge hybrid allowed vlan all	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system
(config-if)#exit	Exit interface mode
(config)#interface mlag3	Entering MLAG interface
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode customer-edge hybrid	Set the switching characteristics of this interface to customer edge hybrid
(config-if)#switchport customer-edge hybrid vlan 2	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN 2
(config-if)#switchport customer-edge hybrid allowed vlanall	Set the switching characteristics of this interface to customer edge hybrid and allow VLAN all
(config-if)#switchport customer-edge vlan registration map1	Configuring the registration table mapping on MLAG interface
(config-if)#exit	Exit interface mode
mcec domain configuration	Entering MCEC mode
(config-mcec-domain)#domain-address 2222.2222.2222	Domain address for the MLAG domain
(config-mcec-domain)#domain-system-number 2	Number to identify the node in a domain
(config-mcec-domain)#intra-domain-link xe49/1	Intra domain line between MLAG domain
(config-mcec-domain)#domain-priority 333	Domain priority for MCEC

SW1

configure terminal	Enter configuration mode
(config)#bridge 1 protocol rstp vlan-bridge	Configuring the RSTP vlan bridge
(config)#interface po1	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all vlan
(config-if)#exit	Exit interface mode
(config)#interface xe1/3	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all vlan

(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode
(config)#interface xe1/1	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1 spanning-tree disable	Associate the interface with bridge group 1 and disabling spanning-tree
(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all vlan
(config-if)#channel-group 1 mode active	Add this interface to channel group 1 and enable link aggregation so that it can be selected for aggregation by the local system.
(config-if)#exit	Exit interface mode
(config)#interface xe3/3	Entering interface mode
(config-if)#switchport	Configuring interface as switchport
(config-if)#bridge-group 1	Associate the interface with bridge group 1and disabling spanning-tree
(config-if)#switchport mode hybrid	Set the switching characteristics of this interface hybrid
(config-if)#switchport hybrid allowed vlan all	Set the switching characteristics of this interface hybrid and allowing all VLAN

Validation

```
TOR1#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1                2             mlag3        0000.0500.0200    1     54
 1                2             mlag3        0000.0500.0201    1     60
 1                2             mlag3        0000.0500.0202    1     54
 1                2             mlag3        0000.0500.0203    1     60
 1                2             mlag3        0000.0500.0204    1     54
 1                2             mlag3        0000.0500.0205    1     60
 1                2             mlag3        0000.0500.0207    1     60
 1                2             mlag3        0000.0500.0208    1     54
 1                2             mlag3        0000.0500.0209    1     60
 1                2             mlag3        0000.0500.020a    1     54
 1                2             mlag3        0000.0500.020b    1     60
 1                2             mlag3        0000.0500.020c    1     54
 1                2             mlag3        0000.0500.020d    1     60
 1                2             mlag3        0000.0500.020e    1     54
 1                2             mlag3        0000.0500.020f    1     60
 1                2             mlag3        0000.0500.0210    1     54
 1                2             mlag3        0000.0500.0211    1     60
 1                2             mlag3        0000.0500.0212    1     54
 1                2             mlag3        cc37.abbb.ed9b    1     40
```

```
TOR1#sh port-security
Port    port-security mode  MAC limit CVLAN  SVLAN  static secure MAC
-------+-------------------+---------+------+------+-----------------
Mlag3   dynamic             10
TOR1#
TOR1#show mac address-table count bridge 1 interface mlag3
MAC Entries for all vlans:
Dynamic Address Count: 20
Static (User-defined) Unicast MAC Address Count: 0
Static (User-defined) Multicast MAC Address Count: 0
Total MAC Addresses in Use: 20
TOR1#
```

CHAPTER 12 Port Breakout Configuration

This chapter contains an overview of splitting single 100G port to 4x10G ports.

Overview

Port Breakout system enables numerous 100GbE ports to be broken out into 4x10GbE, 4x25GbE, 2x50GbE ports through a secure, highly reliable breakout cabling solution. Today's large-scale virtualized datacenter networks require a mix of 10Gb, 25Gb, 40Gb and 100Gb Ethernet interface speeds able to utilize the widest range of flexible connectivity options. These same networks require a variety of cost-effective cabling options for both addressing connectivity and allowing for simple migrations as network speeds and density requirements evolve. As data centers scale and bandwidth demands increase, the networking infrastructure must be capable of scaling with it. Port Breakout feature provides flexibility in splitting 100G to 4x10G, 4x25G, 2x50G cabling and vice-versa whenever requires, and hence provide Administrator a great flexibility in choosing the port speed as per their requirement. A Port Breakout group consists of 4 ports, first port will be control port and the rest 3 are subsidiary ports. Naming of Control port and its subsidiary port is as below

xe50/1, xe50/2, xe50/3, xe50/4

In xe50, numeral 50 indicates the slot of the port on a board and numerals after "/" indicates port numbers on that slot. First port (interface 50/1 in above example) is always control port whereas the rest 3 ports (ports 50/2, 50/3 and 50/4) are subsidiary ports. Only Control port can become 100G port.

Currently below breakout options are available

- 100G ports
  - 100G to 4x10G breakout ports
  - 100G to 4x25G breakout ports (due to HW limitation Autoneg isn't supported)
  - 100G to 2x50G breakout ports (due to HW limitation Autoneg isn't supported).

Note: There are some configuration restrictions for Subsidiary ports such as:

1. Port breakout enable/disable is not allowed on Subsidiary ports.
2. Speed, Duplex configurations are not allowed on InActive Subsidiary ports.
3. One control port and subsidiary ports will be supported in 100g to 2x50G breakout

For Example: Port XE1/1(control port) and XE1/3(subsidiary port) will be active out of 4 ports.

Terminology

Following is a brief description of terms and concepts used to describe port breakout.

Ctl: Control port

A 100G splitable port is called Control port.

Brk: Port Breakout

A control port which is split into 4x10G 4x25G or 2x50 ports.

Subsidiary ports

Ports which are members of Control Port, A subsidiary port can be Active or InActive

IA: InActive Ports

Subsidiary ports whose control port is not configured for “Port Breakout”

Pre-Requisite

From OcNOS version 5.1 onwards, before doing the Port breakout we need to reserve the VLANs using the CLI `vlan-reservation vlan-id/vlan-range`.

The main purpose of this vlan-reservation is when port breakout is not required, then Maximum vlans upto 4062 can be used for bridge configuration.

Note: Once VLANs are reserved, those vlans cannot be used for bridge configuration.

Note: We can release the reserved vlans by unconfiguring the `no port breakout enable` and `no vlan-reservation vlan-id/vlan-range`.

Note: Released VLANs can be used for bridge configuration.

Configuring vlan-reservation

Configuring Port Breakout (40G to 4x10G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)# vlan database`	Enter vlan database
`(config-if)# vlan-reservation 4050-4058`	Specify the vlan-range that should be reserved for interface port Breakout.
`(config-if)#exit`	Exit vlan database.

Unconfiguring vlan-reservation

Configuring Port Breakout (40G to 4x10G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)# vlan database`	Enter vlan database
`(config-if)# no vlan-reservation 4050-4058`	Specify the vlan-range/id that should be released
`(config-if)#exit`	Exit vlan database.

Validation

Below output before applying port-breakout config on xe50/1:

```
 #show vlan-reservation
VLAN ID          Status
=======          ======
4050             free
4051             free
4052             free
4053             free
4054             free
4055             free
4056             free
4057             free
4058             free
```

Configuring Port Breakout 40G to 4x10G

Configuring Port Breakout (40G to 4x10G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)#interface xe50/1`	Specify the interface `(xe5/1)` to be configured for port Breakout.
`(config-if)# port breakout enable 4X10g`	Configure port breakout on interface
`(config-if)#exit`	Exit interface mode.

Removing Port Breakout

Removing Port Breakout is provided in below section.

Note: Interface xe50/1 is back to back connected and interfaces are up.

`#configure terminal`	Enter configure mode.
`(config)#interface xe50/1`	Specify the interface `(xe5/1)` to be configured for port Breakout.
`(config-if)#no port breakout`	Unconfigure port breakout on interface
`(config-if)#exit`	Exit interface mode.

Validation

```
#show interface brief

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down, IA - InActive
       PD(Min-links) - Protocol Down Min-links
       DV - DDM Violation, NA - Not Applicable
```

```
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)


-------------------------------------------------------------------------------
--
Interface     Type             Status  Reason  Speed
Interface
-------------------------------------------------------------------------------
--
eth0          METH             up      --      1g


-------------------------------------------------------------------------------
--
Interface    Status      Description
-------------------------------------------------------------------------------
--
lo           up          --
lo.management  up          --


-------------------------------------------------------------------------------
--
Ethernet   Type  PVID  Mode              Status  Reason  Speed Port    Ctl Br/
Bu
Interface                                                    Ch #
-------------------------------------------------------------------------------
--
xe1        ETH   --    routed            up      none    1g    --       Bu  No
xe2        ETH   --    routed            down    PD      10g   --       No  No
xe3        ETH   --    routed            down    PD      10g   --       No  No
xe4        ETH   --    routed            down    PD      10g   --       No  No
xe5        ETH   --    routed            down    PD      10g   --       Bu  No
xe6        ETH   --    routed            down    PD      10g   --       No  No
xe7        ETH   --    routed            down    PD      10g   --       No  No
xe8        ETH   --    routed            down    PD      10g   --       No  No
xe9        ETH   --    routed            down    PD      10g   --       Bu  No
xe10       ETH   --    routed            down    PD      10g   --       No  No
xe11       ETH   --    routed            down    PD      10g   --       No  No
xe12       ETH   --    routed            down    PD      10g   --       No  No
xe13       ETH   --    routed            down    PD      10g   --       Bu  No
xe14       ETH   --    routed            down    PD      10g   --       No  No
xe15       ETH   --    routed            down    PD      10g   --       No  No
xe16       ETH   --    routed            down    PD      10g   --       No  No
xe17       ETH   --    routed            down    PD      10g   --       Bu  No
xe18       ETH   --    routed            down    PD      10g   --       No  No
xe19       ETH   --    routed            down    PD      10g   --       No  No
xe20       ETH   --    routed            down    PD      10g   --       No  No
xe21       ETH   --    routed            down    PD      10g   --       Bu  No
xe22       ETH   --    routed            down    PD      10g   --       No  No
xe23       ETH   --    routed            down    PD      10g   --       No  No
xe24       ETH   --    routed            down    PD      10g   --       No  No
xe25       ETH   --    routed            up      none    10g   --       Bu  No
xe26       ETH   --    routed            down    PD      10g   --       No  No
xe27       ETH   --    routed            up      none    10g   --       No  No
xe28       ETH   --    routed            down    PD      10g   --       No  No
xe29       ETH   --    routed            down    PD      10g   --       Bu  No
```

```
xe30       ETH   --    routed            down    PD      10g   --       No  No
xe31       ETH   --    routed            down    PD      10g   --       No  No
xe32       ETH   --    routed            down    PD      10g   --       No  No
xe33       ETH   --    routed            down    PD      10g   --       Bu  No
xe34       ETH   --    routed            down    PD      10g   --       No  No
xe35       ETH   --    routed            down    PD      10g   --       No  No
xe36       ETH   --    routed            down    PD      10g   --       No  No
xe37       ETH   --    routed            down    PD      10g   --       Bu  No
xe38       ETH   --    routed            down    PD      10g   --       No  No
xe39       ETH   --    routed            down    PD      10g   --       No  No
xe40       ETH   --    routed            down    PD      10g   --       No  No
xe41       ETH   --    routed            down    PD      10g   --       Bu  No
xe42       ETH   --    routed            down    PD      10g   --       No  No
xe43       ETH   --    routed            down    PD      10g   --       No  No
xe44       ETH   --    routed            down    PD      10g   --       No  No
xe45       ETH   --    routed            down    PD      10g   --       Bu  No
xe46       ETH   --    routed            down    PD      10g   --       No  No
xe47       ETH   --    routed            down    PD      10g   --       No  No
xe48       ETH   --    routed            down    PD      10g   --       No  No
xe49/1     ETH   --    routed            down    PD      40g   --       Br  No
xe49/2     ETH   --    routed            down    IA      --    --       No  No
xe49/3     ETH   --    routed            down    IA      --    --       No  No
xe49/4     ETH   --    routed            down    IA      --    --       No  No
xe50/1     ETH   --    routed            up      none    40g   --       Br  No
xe50/2     ETH   --    routed            down    IA      --    --       No  No
xe50/3     ETH   --    routed            down    IA      --    --       No  No
xe50/4     ETH   --    routed            down    IA      --    --       No

#show interface xe50/1
Interface xe50/1
  Flexport: Breakout Control Port (Active): Break Out disabled
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba4  Logical:(not set)
  Port Mode is Router
  Interface index: 10053
  Metric 1 mtu 1500 duplex-full link-speed 40g
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:42:15 (00:03:20 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 20 bits/sec, 0 packets/sec
  5 minute output rate 20 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 7 broadcast packets 0
    input packets 7 bytes 766
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 0
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 7 broadcast packets 0
    output packets 7 bytes 766
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
```

```
    output discard 0
    Tx pause 0

#show interface xe50/2
Interface xe50/2
  Flexport: Non Control Port (InActive)
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba5  Logical:(not set)
  Port Mode is Router
  Interface index: 10054
  Metric 1 mtu 1500
  <UP,BROADCAST,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:42:15 (00:03:46 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 0 broadcast packets 0
    input packets 0 bytes 0
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 0
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 0 broadcast packets 0
    output packets 0 bytes 0
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
    output discard 0
    Tx pause 0

#show interface xe50/3
Interface xe50/3
  Flexport: Non Control Port (InActive)
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba6  Logical:(not set)
  Port Mode is Router
  Interface index: 10055
  Metric 1 mtu 1500
  <UP,BROADCAST,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:42:15 (00:07:30 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 0 broadcast packets 0
    input packets 0 bytes 0
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 0
```

```
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 0 broadcast packets 0
    output packets 0 bytes 0
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
    output discard 0
    Tx pause 0

#show interface xe50/4
Interface xe50/4
  Flexport: Non Control Port (InActive)
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba7  Logical:(not set)
  Port Mode is Router
  Interface index: 10056
  Metric 1 mtu 1500
  <UP,BROADCAST,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:42:15 (00:07:36 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 0 broadcast packets 0
    input packets 0 bytes 0
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 0
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 0 broadcast packets 0
    output packets 0 bytes 0
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
    output discard 0
    Tx pause 0
```

Here xe50/1 is a control Port whereas xe50/2, xe50/3 and xe50/4 are their subsidiary ports. The out-put shows only xe50/1 is active (interface up and running) whereas other ports are inactive (interface up but not running).

Below Outputs after applying port-breakout configured on xe50/1:

VLAN-reservation validation:

```
#show vlan-reservation
VLAN ID         Status
=======         ======
4050            allocated
4051            allocated
4052            allocated
4053            free
4054            free
```

```
4055            free
4056            free
4057            free
4058            free

#show interface brief

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down, IA - InActive
       PD(Min-links) - Protocol Down Min-links
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)


------------------------------------------------------------------------------
--
Interface     Type             Status  Reason  Speed
Interface
------------------------------------------------------------------------------
--
eth0          METH             up      --      1g


------------------------------------------------------------------------------
--
Interface    Status      Description
------------------------------------------------------------------------------
--
lo           up          --
lo.management  up          --


------------------------------------------------------------------------------
--
Ethernet   Type  PVID  Mode              Status  Reason  Speed Port    Ctl Br/
Bu
Interface                                                    Ch #
------------------------------------------------------------------------------
--
xe1        ETH   --    routed            up      none    1g    --       Bu  No
xe2        ETH   --    routed            down    PD      10g   --       No  No
xe3        ETH   --    routed            down    PD      10g   --       No  No
xe4        ETH   --    routed            down    PD      10g   --       No  No
xe5        ETH   --    routed            down    PD      10g   --       Bu  No
xe6        ETH   --    routed            down    PD      10g   --       No  No
xe7        ETH   --    routed            down    PD      10g   --       No  No
xe8        ETH   --    routed            down    PD      10g   --       No  No
xe9        ETH   --    routed            down    PD      10g   --       Bu  No
xe10       ETH   --    routed            down    PD      10g   --       No  No
xe11       ETH   --    routed            down    PD      10g   --       No  No
xe12       ETH   --    routed            down    PD      10g   --       No  No
xe13       ETH   --    routed            down    PD      10g   --       Bu  No
xe14       ETH   --    routed            down    PD      10g   --       No  No
```

```
xe15       ETH   --    routed           down    PD      10g   --       No  No
xe16       ETH   --    routed           down    PD      10g   --       No  No
xe17       ETH   --    routed           down    PD      10g   --       Bu  No
xe18       ETH   --    routed           down    PD      10g   --       No  No
xe19       ETH   --    routed           down    PD      10g   --       No  No
xe20       ETH   --    routed           down    PD      10g   --       No  No
xe21       ETH   --    routed           down    PD      10g   --       Bu  No
xe22       ETH   --    routed           down    PD      10g   --       No  No
xe23       ETH   --    routed           down    PD      10g   --       No  No
xe24       ETH   --    routed           down    PD      10g   --       No  No
xe25       ETH   --    routed           up      none    10g   --       Bu  No
xe26       ETH   --    routed           down    PD      10g   --       No  No
xe27       ETH   --    routed           up      none    10g   --       No  No
xe28       ETH   --    routed           down    PD      10g   --       No  No
xe29       ETH   --    routed           down    PD      10g   --       Bu  No
xe30       ETH   --    routed           down    PD      10g   --       No  No
xe31       ETH   --    routed           down    PD      10g   --       No  No
xe32       ETH   --    routed           down    PD      10g   --       No  No
xe33       ETH   --    routed           down    PD      10g   --       Bu  No
xe34       ETH   --    routed           down    PD      10g   --       No  No
xe35       ETH   --    routed           down    PD      10g   --       No  No
xe36       ETH   --    routed           down    PD      10g   --       No  No
xe37       ETH   --    routed           down    PD      10g   --       Bu  No
xe38       ETH   --    routed           down    PD      10g   --       No  No
xe39       ETH   --    routed           down    PD      10g   --       No  No
xe40       ETH   --    routed           down    PD      10g   --       No  No
xe41       ETH   --    routed           down    PD      10g   --       Bu  No
xe42       ETH   --    routed           down    PD      10g   --       No  No
xe43       ETH   --    routed           down    PD      10g   --       No  No
xe44       ETH   --    routed           down    PD      10g   --       No  No
xe45       ETH   --    routed           down    PD      10g   --       Bu  No
xe46       ETH   --    routed           down    PD      10g   --       No  No
xe47       ETH   --    routed           down    PD      10g   --       No  No
xe48       ETH   --    routed           down    PD      10g   --       No  No
xe49/1     ETH   --    routed           down    PD      40g   --       Br  No
xe49/2     ETH   --    routed           down    IA      --    --       No  No
xe49/3     ETH   --    routed           down    IA      --    --       No  No
xe49/4     ETH   --    routed           down    IA      --    --       No  No
xe50/1     ETH   --    routed           up      none    10g   --       Br Yes
xe50/2     ETH   --    routed           up      none    10g   --       No  No
xe50/3     ETH   --    routed           up      none    10g   --       No  No
xe50/4     ETH   --    routed           up      none    10g   --       No

#show interface xe50/1
Interface xe50/1
  Flexport: Breakout Control Port (Active): Break Out Enabled
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba4  Logical:(not set)
  Port Mode is Router
  Interface index: 10053
  Metric 1 mtu 1500 duplex-full link-speed 10g
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:54:58 (00:32:03 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
```

```
    5 minute input rate 0 bits/sec, 0 packets/sec
    5 minute output rate 0 bits/sec, 0 packets/sec
    RX
      unicast packets 0 multicast packets 7 broadcast packets 0
      input packets 23 bytes 801
      jumbo packets 0
      runts 0 giants 0 CRC 0 fragments 0 jabbers 0
      input error 16
      input with dribble 0 input discard 0
      Rx pause 0
    TX
      unicast packets 0 multicast packets 14 broadcast packets 0
      output packets 14 bytes 1532
      jumbo packets 0
      output errors 0 collision 0 deferred 0 late collision 0
      output discard 0
      Tx pause 0

  #show interface xe50/2
  Interface xe50/2
    Flexport: Non Control Port (Active)
    Hardware is ETH  Current HW addr: a82b.b5ad.db6f
    Physical:a82b.b5ad.dba5  Logical:(not set)
    Port Mode is Router
    Interface index: 10054
    Metric 1 mtu 1500 duplex-full link-speed 10g
    <UP,BROADCAST,RUNNING,MULTICAST>
    VRF Binding: Not bound
    DHCP client is disabled.
    Last Flapped: 2001 Feb 13 18:42:15 (00:45:16 ago)
    Statistics last cleared: Never
    inet6 fe80::aa2b:b5ff:fead:db6f/64
    5 minute input rate 0 bits/sec, 0 packets/sec
    5 minute output rate 0 bits/sec, 0 packets/sec
    RX
      unicast packets 0 multicast packets 7 broadcast packets 0
      input packets 23 bytes 790
      jumbo packets 0
      runts 0 giants 0 CRC 0 fragments 0 jabbers 0
      input error 16
      input with dribble 0 input discard 0
      Rx pause 0
    TX
      unicast packets 0 multicast packets 7 broadcast packets 0
      output packets 7 bytes 766
      jumbo packets 0
      output errors 0 collision 0 deferred 0 late collision 0
      output discard 0
      Tx pause 0

  #show interface xe50/3
  Interface xe50/3
    Flexport: Non Control Port (Active)
    Hardware is ETH  Current HW addr: a82b.b5ad.db6f
    Physical:a82b.b5ad.dba6  Logical:(not set)
    Port Mode is Router
```

```
  Interface index: 10055
  Metric 1 mtu 1500 duplex-full link-speed 10g
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:42:15 (00:45:31 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 7 broadcast packets 0
    input packets 26 bytes 801
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 19
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 7 broadcast packets 0
    output packets 7 bytes 766
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
    output discard 0
    Tx pause 0

#show interface xe50/4
Interface xe50/4
  Flexport: Non Control Port (Active)
  Hardware is ETH  Current HW addr: a82b.b5ad.db6f
  Physical:a82b.b5ad.dba7  Logical:(not set)
  Port Mode is Router
  Interface index: 10056
  Metric 1 mtu 1500 duplex-full link-speed 10g
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  DHCP client is disabled.
  Last Flapped: 2001 Feb 13 18:54:58 (00:33:07 ago)
  Statistics last cleared: Never
  inet6 fe80::aa2b:b5ff:fead:db6f/64
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  RX
    unicast packets 0 multicast packets 7 broadcast packets 0
    input packets 22 bytes 792
    jumbo packets 0
    runts 0 giants 0 CRC 0 fragments 0 jabbers 0
    input error 15
    input with dribble 0 input discard 0
    Rx pause 0
  TX
    unicast packets 0 multicast packets 14 broadcast packets 0
    output packets 14 bytes 1532
    jumbo packets 0
    output errors 0 collision 0 deferred 0 late collision 0
    output discard 0
    Tx pause 0
```

Configuring Port Breakout (100G to 4x10G)

Configuring Port Breakout (100G to 4x10G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)#interface ce1/1`	Specify the interface `(ce1/1)` to be configured for port Breakout.
`(config-if)#port breakout enable 4x10g`	Configure port breakout on interface
`(config-if)#exit`	Exit interface mode.

Note: Interface ce1/1 is back to back connected and interfaces are up.

Validation

VLAN-reservation validation

```
#show vlan-reservation
VLAN ID         Status
=======         ======
4050            allocated
4051            allocated
4052            allocated
4053            allocated
4054            allocated
4055            allocated
4056            free
4057            free
4058            free

#show interface brief

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down, IA - InActive
       PD(Min-links) - Protocol Down Min-links
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)


--------------------------------------------------------------------------------
--
Ethernet   Type  PVID  Mode             Status  Reason  Speed Port    Ctl Br/
Bu
Interface                                                      Ch #
--------------------------------------------------------------------------------
--
```

```
ce1/1      ETH    --    routed            up      none    10g    --       Br Yes
ce1/2      ETH    --    routed            up      none    10g    --       No  No
ce1/3      ETH    --    routed            up      none    10g    --       No  No
ce1/4      ETH    --    routed            up      none    10g    --       No  No
```

Configuring Port Breakout (100G to 4x25G)

Configuring Port Breakout (100G to 4x25G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)#interface ce1/1`	Specify the interface `(ce1/1)` to be configured for port Breakout.
`(config-if)#port breakout enable 4x25g`	Configure port breakout on interface
`(config-if)#exit`	Exit interface mode.

Note: Interface ce1/1 is back to back connected and interfaces are up.

Validation

VLAN-reservation validation

```
#show vlan-reservation
VLAN ID          Status
=======          ======
4050             allocated
4051             allocated
4052             allocated
4053             allocated
4054             allocated
4055             allocated
4056             free
4057             free
4058             free

#show interface brief

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down, IA - InActive
       PD(Min-links) - Protocol Down Min-links
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)

--------------------------------------------------------------------------
--
Ethernet   Type  PVID  Mode           Status  Reason  Speed Port    Ctl Br/Bu
Interface                                                    Ch #
```

```
-------------------------------------------------------------------------------
--
ce1/1       ETH    --     routed              up       none     25g    --        Br
Yes
ce1/2       ETH    --     routed              up       none     25g    --        No   No
ce1/3       ETH    --     routed              up       none     25g    --        No   No
ce1/4       ETH    --     routed              up       none     25g    --        No   No
```

Configuring Port Breakout (100G to 2x50G)

Configuring Port Breakout (100G to 2x50G) is provided in below section.

`#configure terminal`	Enter configure mode.
`(config)#interface ce1/1`	Specify the interface `(ce1/1)` to be configured for port Breakout.
`(config-if)#port breakout enable 2x50g`	Configure port breakout on interface
`(config-if)#exit`	Exit interface mode.

Note: Interface ce1/1 is back to back connected and interfaces are up.

Validation

VLAN-reservation validation

```
#show vlan-reservation
VLAN ID          Status
=======          ======
4050             allocated
4051             allocated
4052             allocated
4053             allocated
4054             allocated
4055             allocated
4056             free
4057             free
4058             free

#show interface brief

Codes: ETH - Ethernet, LB - Loopback, AGG - Aggregate, MLAG - MLAG Aggregate
       FR - Frame Relay, TUN -Tunnel, PBB - PBB Logical Port, VP - Virtual
Port
       CVP - Channelised Virtual Port, METH - Management Ethernet, UNK-
Unknown
       ED - ErrDisabled, PD - Protocol Down, AD - Admin Down, IA - InActive
       PD(Min-links) - Protocol Down Min-links
       DV - DDM Violation, NA - Not Applicable
       NOM - No operational members, PVID - Port Vlan-id
       Ctl - Control Port (Br-Breakout/Bu-Bundle)
```

```
-------------------------------------------------------------------------------
--
Ethernet   Type  PVID  Mode              Status  Reason  Speed Port    Ctl Br/
Bu
Interface                                                      Ch #
-------------------------------------------------------------------------------
--
ce1/1      ETH   --    routed            up      none    50g   --       Br
Yes
ce1/2      ETH   --    routed            down    IA      --    --       No  No
ce1/3      ETH   --    routed            up      none    50g   --       No  No
ce1/4      ETH   --    routed            down    IA      --    --       No  No
```

CHAPTER 13 Layer 2 Control Protocols Tunneling

Overview

The Layer 2 Control Protocols (L2CP) processing specified here is based largely on the IEEE 802.1Q specification for handling L2CP Frames, i.e. if they should be forwarded, peered, or discarded.

IEEE 802.1Q provides a mechanism for separating the Layer2 control plane into multiple customer and provider control planes. It allows a certain layer 2 control protocol to operate only within a provider network, or to allow interaction between the customer and the provider network, or to pass transparently through a provider network with complete isolation from other customer networks.

In case of non-PB case, packet is forwarded without changing any MAC.

L2CP Tunneling for Provider Bridging

L2CP tunneling provides support for tunneling control plane frames between CE nodes.

In the context of PB, a L2CP frame is defined as any frame containing a destination MAC address as 01:00:0C:CD:CD:D0 or 01:04:DF:CD:CD:D0 (which can be changed via CLI)

When control frames received at CEP port of a PE bridge, predefined multicast address (01-00-C2-CD-CD-D0) is replaced as destination for tunneling the packets across service provider network. If control packets are customer vlan tagged or untagged, then PE bridge will append corresponding service vlan tag to the control packet as per registration table / vlan translation table mapped to the port and send it across the service provider as a data packet.

When tunneled control packet with multicast address (01-00-C2-CD-CD-D0) received on PNP port, the multicast address is replaced with corresponding control packet multicast address and cvlan/svlan removal or update is done as per registration table / vlan translation table.

Figure 13-21: L2CP tunneling for provider bridging

L2CP Tunneling for VPLS/VPWS/Hybrid (Bridge+VPWS)

L2CP tunneling provides support for tunneling Control plane frames across L2VPN.

L2CP Tunneling for VXLAN

L2CP tunneling provides support for tunneling Control plane frames across VxLAN/MH.

Topology

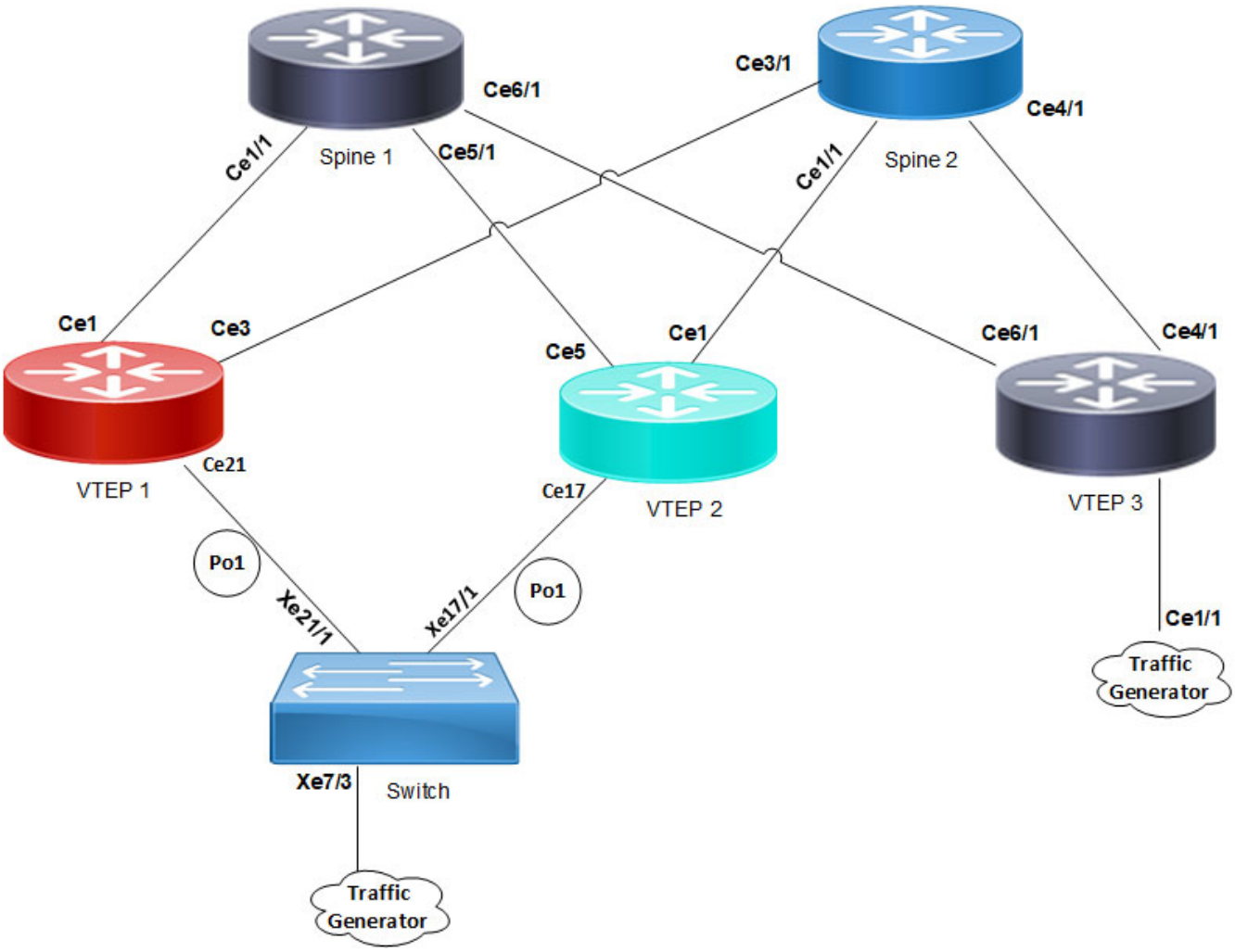


Figure 13-22: L2CP tunneling for VXLAN

VXLAN creates LAN segments using a MAC in IP encapsulation. The encapsulation carries the original L2 frame received from a host to the destination in another server using IP tunnels. The endpoints of the virtualized tunnel formed using VXLAN are called VTEPs (VXLAN Tunnel EndPoints).

L2CP tunneling provides support for tunneling control plane frames across VXLAN with MH/SH combination.

Any L2CP frame that is destined towards other end with a multicast destination MAC Address for L2 protocol is decided by looking at the frame and upon the configured values of the L2CP Service Attributes.

As and when Control packets with default destination MAC address for any L2 protocol is generated, it will be forwarded by VTEPs that are part of MH towards the VTEP that is part of SH and vice versa.

During this operation, the default destination MAC address for any L2 protocol is replaced with predefined multicast address as destination for tunneling the packets across SPINE nodes. When tunneled control packet with pre-defined multicast address received on ingress port on the other end of the VTEP, the multicast address is replaced with corresponding control packet multicast address.

Default Behavior

If control packets are received at the PE router on AC port (vlan tagged/untagged), corresponding AC port properties will take care of forwarding to peer PE node. These packets are encapsulated with MPLS headers and sent across the network to the remote PE router. The egress PE router receives the packet and performs MPLS decapsulation and forwards to the CE. Except for LACP, all other control packets are tunnels across the MPLS circuit.

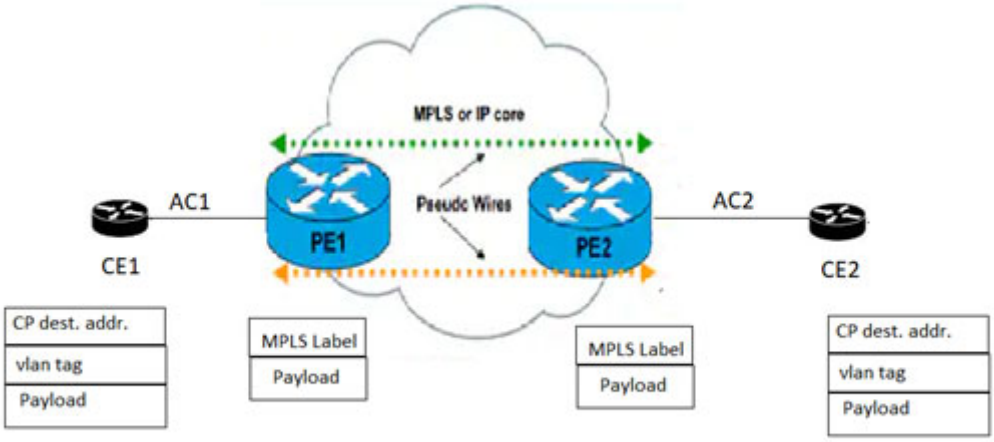


Figure 13-23: L2CP tunneling for VPLS/VPWS/Hybrid (bridge+VPWS)

Hybrid Port

When the incoming port is configured as Hybrid (Bridge+L2VPN), L2CP switches to peering mode. You can override this behavior with the help of L2CP configurations.

L2CP Behavior

The action taken for a given L2CP Frame at a given L2CP Decision Point depends upon the Destination Address within the frame, and upon the configured values of the L2CP Service Attributes.

The three possible actions at an L2CP Decision Points are: Discard, Peer, or Pass/Tunnel.

Discard	The L2CP frame is neither peered nor forwarded.
Peer	The L2CP frame will be processed.
Pass/Tunnel	Pass (or forwarded) means that the frame will be passed transparently in the same way as normal data frames.

Default L2CP configuration

Default L2CP decision in Provider Bridging case:

Table 13-1: Default L2CP decision for Provider Bridging

Protocol Type	L2CP destination address	Ethertype/subtype	Default L2CP action
STP (Spanning Tree Protocols)	01-80-c2-00-00-00	N/A	PEER
LACP (Link Aggregation Control Protocol)	01-80-c2-00-00-02	ethertype 0x8809 and subtype 0x1 or 0x2	PEER
DOT1X (Port Authentication (802.1 X))	01-80-c2-00-00-03	N/A	PEER
LLDP (Link layer discovery protocol)	01-80-c2-00-00-0e	ethertype 0x88CC	PEER
EFM (Ethernet first mile (Link OAM))	01-80-c2-00-00-02	ethertype 0x8809 and subtype 0x3	PEER
ELMI (Ethernet Local Management Interface)	01-80-c2-00-00-07	ethertype 0x88EE	PEER

Default L2CP Decision in VPLS/VPWS/Hybrid case:

- For bridged packets in case of hybrid port:

Table 13-2: Default L2CP decision for hybrid port

Protocol Type	L2CP destination address	Default L2CP action
STP(Spanning Tree Protocols)	01-80-c2-00-00-00	PEER
LACP (Link Aggregation Control Protocol)	01-80-c2-00-00-02	PEER
DOT1X (Port Authentication (802.1 X))	01-80-c2-00-00-03	PEER
LLDP (Link layer discovery protocol)	01-80-c2-00-00-0e	PEER
EFM (Ethernet first mile (Link OAM))	01-80-c2-00-00-02	PEER
ELMI (Ethernet Local Management Interface)	01-80-c2-00-00-07	PEER

- For VPLS/VPWS:

Table 13-3: Default L2CP decision for VPLS/VPWS

Protocol Type	L2CP destination address	Default L2CP action
STP(Spanning Tree Protocols)	01-80-c2-00-00-00	TUNEEL
LACP (Link Aggregation Control Protocol)	01-80-c2-00-00-02	PEER

Table 13-3: Default L2CP decision for VPLS/VPWS (Continued)

Protocol Type	L2CP destination address	Default L2CP action
DOT1X (Port Authentication (802.1 X))	01-80-c2-00-00-03	TUNNEL
LLDP (Link layer discovery protocol)	01-80-c2-00-00-0e	TUNNEL
EFM (Ethernet first mile (Link OAM))	01-80-c2-00-00-02	TUNNEL
ELMI (Ethernet Local Management Interface)	01-80-c2-00-00-07	TUNNEL

Operational Concepts and Scenarios

Basic Configuration for L2CP for Hybrid+VPLS

Enabling tunneling at bridged interface:

```
(config-if)#show run in xe11
!
interface xe11
 speed 1g
 switchport
 bridge-group 1
 switchport mode trunk
 switchport trunk allowed vlan all
 mpls-l2-circuit vc1 service-template svc1

#config ter
#(config)interface xe11
(config-if)#l2protocol stp tunnel
(config-if)#commit
(config-if)#end
```

To display L2CP information:

```
#show l2protocol processing interface xe11
Bridge   Interface Name  Protocol     Processing Status     Hardware Status
======   ==============  ========     =================     ===============
-        xe11             stp          Tunnel                Tunnel
-        xe11             lacp         None                  Peer
-        xe11             dot1x        None                  Peer
-        xe11             lldp         None                  Peer
-        xe11             efm          None                  Peer
-        xe11             elmi         None                  Peer

(config)#in xe11
(config-if)#no l2protocol stp
(config-if)#end
```

```
#show l2protocol processing interface xe11
Bridge   Interface Name  Protocol     Processing Status     Hardware Status
======   ==============  ========     =================     ===============
-        xe11             stp          None                  Peer
-        xe11             lacp         None                  Peer
-        xe11             dot1x        None                  Peer
-        xe11             lldp         None                  Peer
-        xe11             efm          None                  Peer
-        xe11             elmi         None                  Peer
```

Note: If the configuration is not done, hardware status shows the default values while the configured will be none. On configuring L2CP on interface, configured and hardware status will be same.

Basic Configuration for L2CP in VPLS

Enabling tunneling at ingress VPLS interface:

```
#show run in xe12
!
interface xe12
 speed 1g
 mpls-l2-circuit vc1 service-template svc1
!
#config ter
#(config)interface xe12
(config-if)#commit
```

To display L2CP information:

```
#show l2protocol processing interface xe12

Bridge   Interface Name  Protocol     Processing Status     Hardware Status
======   ==============  ========     =================     ===============
-        xe12             stp          Discard               Discard
-        xe12             lacp         None                  Peer
-        xe12             dot1x        None                  Tunnel
-        xe12             lldp         None                  Tunnel
-        xe12             efm          None                  Tunnel
-        xe12             elmi         None                  Tunnel
```

Basic Configuration for L2CP on Provider Bridging

Enabling tunneling at interface:

```
(config)#bridge 1 protocol provider-rstp edge
(config)#vlan database
(config-vlan)#vlan 2-10 bridge 1 state enable
(config-vlan)#vlan 11 type service point-point bridge 1 state enable
(config-vlan)#ex
(config)#cvlan registration table map1 bridge 1
(config-cvlan-registration)#cvlan 2 svlan 11
(config-cvlan-registration)#ex
```

```
(config)#interface xe1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode customer-edge hybrid
(config-if)#switchport customer-edge hybrid allowed vlan all
(config-if)#switchport customer-edge vlan registration map1
(config-if)#l2protocol stp tunnel
#show running-config interface xe1
!
 interface xe1
 speed 1g
 switchport
 bridge-group 1
 switchport mode customer-edge hybrid
 switchport customer-edge hybrid allowed vlan all
 switchport customer-edge vlan registration map1
 l2protocol stp tunnel
 customer-spanning-tree provider-edge svlan 11 path-cost 128
(config-if)#commit
```

Configuring egress interfaces”

```
(config)#interface xe2
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode provider-network
(config-if)#switchport provider-network allowed vlan all
(config-if)#commit
```

To display L2protocol information:

```
#show l2protocol processing interface xe1
Bridge   Interface Name  Protocol     Processing Status     Hardware Status
======   ==============  ========     =================     ===============
1        xe1             stp          Tunnel                Tunnel
1        xe1             lacp         Peer                  Peer
1        xe1             dot1x        Peer                  Peer
1        xe1             lldp         Peer                  Peer
1        xe1             efm          Peer                  Peer
1        xe1             elmi         Peer                  Peer
```

To display L2protocol counters:

```
#show l2protocol interface counters
Interface xe1
Tunnel               :  stp                 : 45
```

CHAPTER 14 Provider Bridging Configuration

This chapter contains sample provider bridging configurations.

A provider bridged network is a virtual bridged Local Area Network that comprises provider bridges (SVLAN bridges and provider edge bridges) and attached LANs, under the administrative control of a single service provider. Provider bridges interconnect the separate MACs of the IEEE 802 LANs that compose a provider bridged network, relaying frames to provide connectivity between all the LANs that provide customer interfaces for each service instance.

Single Provider Bridge Configuration

Topology

Figure 14-24: Single provider bridge configuration

Configuration

SW1 (PEB)

`SW1#configure terminal`	Enter configuration mode
`SW1(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW1(config)#vlan database`	Enter VLAN configuration mode
`SW1(config-vlan)#vlan 2 type customer bridge 1 state enable`	Create customer vlan VLAN 2
`SW1(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW1(config-vlan)#exit`	Exit VLAN configuration mode
`SW1(config)#cvlan registration table map1 bridge 1`	Create cvlan registration table map1
`SW1(config-cvlan-registration)#cvlan 2 svlan 200`	Map cvlan2 with svlan 200
`SW1(config-cvlan-registration)#exit`	Exit registration table
`SW1(config)#interface eth1`	Enter interface configuration mode for eth1
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode customer-edge access`	Configure switchport mode customer edge
`SW1(config-if)#switchport customer-edge access vlan 2`	Associate customer vlan2 with interface

`SW1(config-if)#switchport customer-edge vlan registration map1`	Attach registration table map1 with interface
`SW1(config-if)#exit`	Exit interface mode
`SW1(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW1(config-if)#switchport`	Make interface as switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW1(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW1(config-if)#exit`	Exit interface configuration mode

SW2 (PB)

`SW2#configure terminal`	Enter configuration mode
`SW2(config)#bridge 1 protocol provider-rstp`	Create provider bridge
`SW2(config)#vlan database`	Enter VLAN configuration mode
`SW2(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW2(config-vlan)#exit`	Exit VLAN configuration mode
`SW2(config)#interface eth1`	Enter interface configuration mode for eth1
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#exit`	Exit interface configuration mode
`SW2(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#exit`	Exit interface configuration mode

SW3 (PEB)

`SW3#configure terminal`	Enter configuration mode
`SW3(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW3(config)#vlan database`	Enter VLAN configuration mode
`SW3(config-vlan)#vlan 2 type customer bridge 1 state enable`	Create customer vlan VLAN 2

`SW3(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW3(config-vlan)#exit`	Exit VLAN configuration mode
`SW3(config)#cvlan registration table map1 bridge 1`	Create cvlan registration table map1
`SW3(config-cvlan-registration)#cvlan 2 svlan 200`	Map cvlan2 with svlan 200
`SW3(config-cvlan-registration)#exit`	Exit registration table
`SW3(config)#interface eth1`	Enter interface configuration mode for eth1
`SW3(config-if)#switchport`	Configure switchport
`SW3(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW3(config-if)#switchport mode customer-edge access`	Configure switchport mode customer edge
`SW3(config-if)#switchport customer-edge access vlan 2`	Associate customer vlan2 with interface
`SW3(config-if)#switchport customer-edge vlan registration map1`	Attach registration table map1 with interface
`SW3(config-if)#exit`	Exit interface mode
`SW3(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW3(config-if)#switchport`	Make interface as switchport
`SW3(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW3(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW3(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW3(config-if)#exit`	Exit interface configuration mode

Validation

```
SW3#sh br
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 --------+------+------+------+-----------+-----------------+-----+---------+
 1                200           eth1         0000.0000.0f00    1     300
 1                200           eth2        0001.0000.0800    1     300

SW1#sh br
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 --------+------+------+------+-----------+-----------------+-----+---------+
 1                200           eth2         0000.0000.0f00    1     300
 1                200           eth1        0001.0000.0800    1     300

SW1#sh cvlan registration table
```

```
Bridge          Table Name       Port List

======          ==========       =========

1               map1             eth1

CVLAN ID        SVLAN ID
========        ========
2               200
```

Two Provider Bridge Configuration

Topology

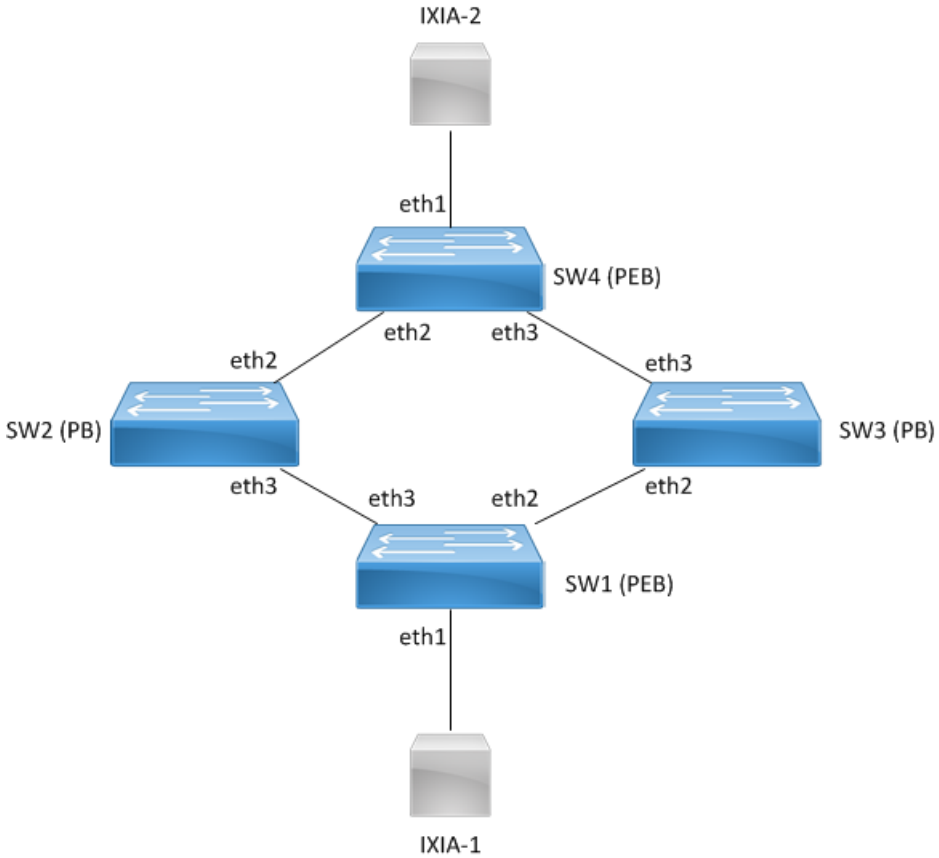


Figure 14-25: Two provider bridge configuration

Configuration

SW1 (PEB)

`SW1#configure terminal`	Enter configuration mode
`SW1(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW1(config)#vlan database`	Enter VLAN configuration mode
`SW1(config-vlan)#vlan 2 type customer bridge 1 state enable`	Create customer vlan VLAN 2
`SW1(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW1(config-vlan)#exit`	Exit VLAN configuration mode
`SW1(config)#cvlan registration table map1 bridge 1`	Create cvlan registration table map1
`SW1(config-cvlan-registration)#cvlan 2 svlan 200`	Map cvlan2 with svlan 200
`SW1(config-cvlan-registration)#exit`	Exit registration table
`SW1(config)#interface eth1`	Enter interface configuration mode for eth1
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode customer-edge access`	Configure switchport mode customer edge
`SW1(config-if)#switchport customer-edge access vlan 2`	Associate customer vlan2 with interface
`SW1(config-if)#switchport customer-edge vlan registration map1`	Attach registration table map1 with interface
`SW1(config-if)#exit`	Exit interface mode
`SW1(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW1(config-if)#switchport`	Make interface as switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW1(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW1(config-if)#interface eth3`	Enter interface configuration mode for eth2
`SW1(config-if)#switchport`	Make interface as switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW1(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW1(config-if)#exit`	Exit interface configuration mode

SW2 (PB)

`SW2#configure terminal`	Enter configuration mode
`SW2(config)#bridge 1 protocol provider-rstp`	Create provider bridge
`SW2(config)#vlan database`	Enter VLAN configuration mode
`SW2(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW2(config-vlan)#exit`	Exit VLAN configuration mode
`SW2(config)#interface eth3`	Enter interface configuration mode for eth1
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#exit`	Exit interface configuration mode
`SW2(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#exit`	Exit interface configuration mode

SW3 (PB)

`SW3#configure terminal`	Enter configuration mode
`SW3(config)#bridge 1 protocol provider-rstp`	Create provider bridge
`SW3(config)#vlan database`	Enter VLAN configuration mode
`SW3(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW3(config-vlan)#exit`	Exit VLAN configuration mode
`SW3(config)#interface eth3`	Enter interface configuration mode for eth1
`SW3(config-if)#switchport`	Make interface as switchport
`SW3(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW3(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW3(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW3(config-if)#exit`	Exit interface configuration mode
`SW3(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW3(config-if)#switchport`	Make interface as switchport
`SW3(config-if)#bridge-group 1`	Associate interface with bridge-group 1

`SW3(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW3(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW3(config-if)#exit`	Exit interface configuration mode

SW4 (PEB)

`SW4#configure terminal`	Enter configuration mode
`SW4(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW4(config)#vlan database`	Enter VLAN configuration mode
`SW4(config-vlan)#vlan 2 type customer bridge 1 state enable`	Create customer vlan VLAN 2
`SW4(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW4(config-vlan)#exit`	Exit VLAN configuration mode
`SW4(config)#cvlan registration table map1 bridge 1`	Create cvlan registration table map1
`SW4(config-cvlan-registration)#cvlan 2 svlan 200`	Map cvlan2 with svlan 200
`SW4(config-cvlan-registration)#exit`	Exit registration table
`SW4(config)#interface eth1`	Enter interface configuration mode for eth1
`SW4(config-if)#switchport`	Configure switchport
`SW4(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW4(config-if)#switchport mode customer-edge access`	Configure switchport mode customer edge
`SW4(config-if)#switchport customer-edge access vlan 2`	Associate customer vlan2 with interface
`SW4(config-if)#switchport customer-edge vlan registration map1`	Attach registration table map1 with interface
`SW4(config-if)#exit`	Exit interface mode
`SW4(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW4(config-if)#switchport`	Make interface as switchport
`SW4(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW4(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW4(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW4(config-if)#interface eth3`	Enter interface configuration mode for eth2
`SW4(config-if)#switchport`	Make interface as switchport
`SW4(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW4(config-if)#switchport mode provider-network`	Configure switchport pnp port

`SW4(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW4(config-if)#exit`	Exit interface configuration mode

Validation

```
SW4#sh br
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be affected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1                200           eth1        0000.0000.0a00    1     300
 1                200           eth2        0001.0000.0b00    1     300

SW1#sh br
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be affected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1                200           eth1        0000.0000.0b00    1     300
 1                200           eth3        0001.0000.0a00    1     300

SW1#sh cvlan registration table
Bridge          Table Name       Port List

======          ==========       =========

1               map1             eth1

CVLAN ID        SVLAN ID
========        ========
2               200
```

Layer 2 Protocol Tunneling (L2PT/L2CP Tunneling)

L2CP tunneling provides support for tunneling Control plane frames between CE nodes.

When control frames received at CEP port of PE bridge, predefined multicast address (01-00-C2-CD-CD-D0) is used for tunneling the packets across service provider network. If control packets are customer vlan tagged or untagged, then PE bridge will append corresponding service vlan tag to the control packet as per registration table / vlan translation table mapped to the port and send it across the service provider as a data packet.

When tunneled control packet with multicast address (01-00-C2-CD-CD-D0) received on PNP port, the multicast address is replaced with corresponding control packet multicast address and cvlan/svlan removal or updating is done as per registration table / vlan translation table.

Topology

Figure 14-26 displays a sample Provider Bridged topology with customer equipment.

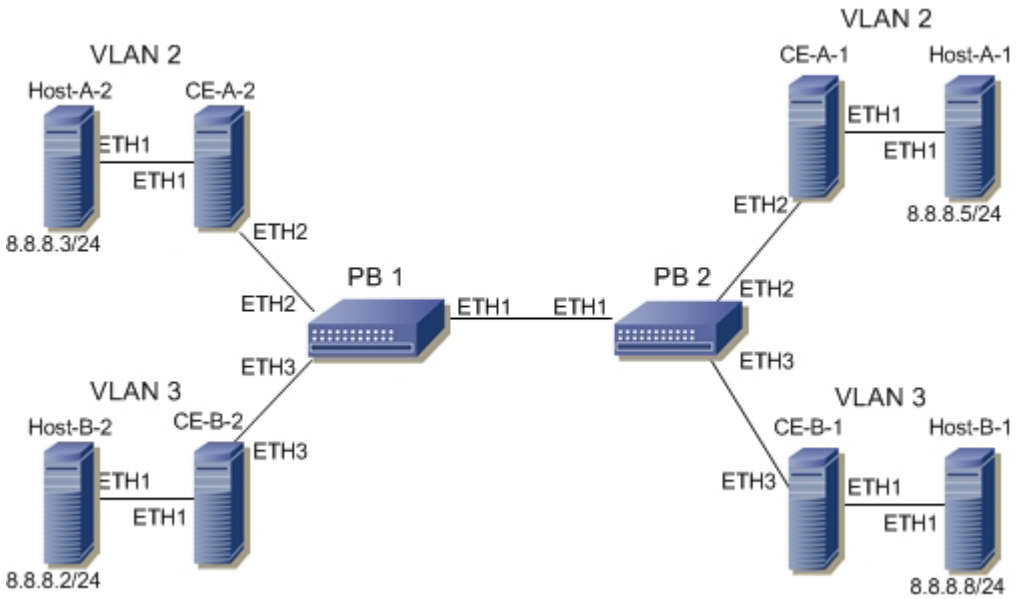


Figure 14-26: Provider Bridging with Customer Equipment Topology

Configuring the L2PT Protocol on the Interface

The following L2PT protocols are supported:

- EFM: Ethernet first mile (Link OAM)
- ELMI: Ethernet Local Management Interface
- LACP: Link Aggregation Control Protocol
- LLDP: Link Layer Discovery Protocol
- STP: Spanning Tree Protocols

PB1

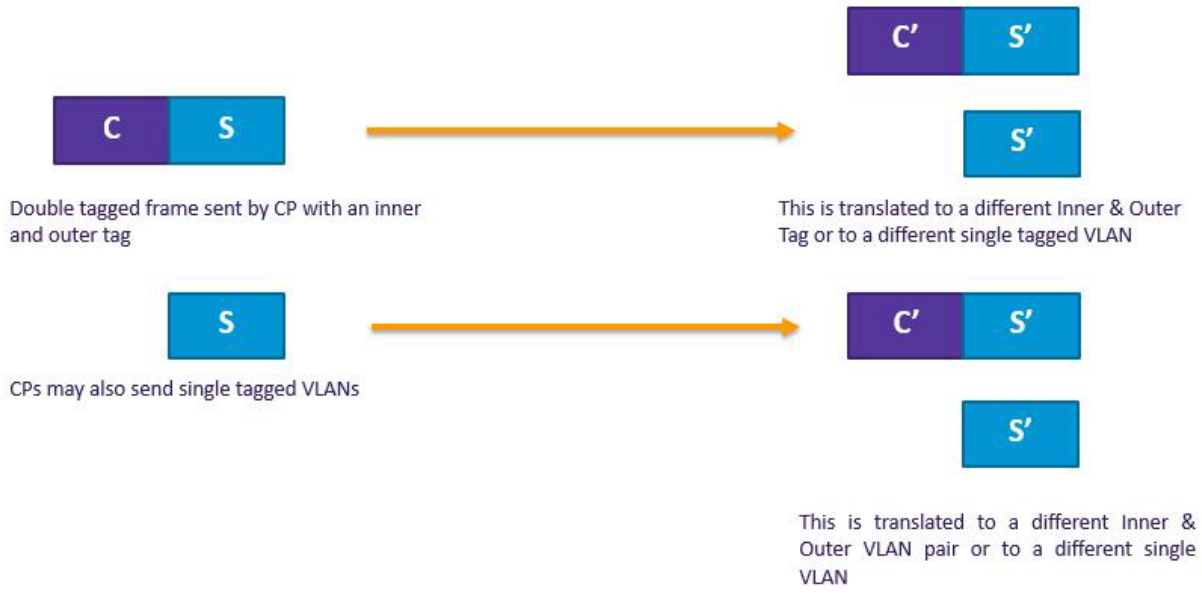
`PB1#configure terminal`	Enter Configure mode.
`PB1(config)#interface eth2`	Enter Interface mode
`PB1(config-if)#l2protocol stp peer`	Configure STP protocol as peer
`PB1(config-if)#l2protocol elmi tunnel`	Configure Elmi protocol as tunnel
`PB1(config-if)#l2protocol lldp tunnel`	Configure LLDP protocol as tunnel
`PB1(config-if)#l2protocol lacp discard`	Configure LACP protocol as discard
`PB1(config-if)#l2protocol efm discard`	Configure EFM protocol as discard
`PB1(config-if)#exit`	Exit of the interface

Validation

```
PB1#show l2protocol processing interface eth2
Bridge    Interface Name                 Protocol       Processing Status
======    ==============                 ========       =================
1         eth2                           stp            Peer
1         eth2                           gmrp           Peer
1         eth2                           gvrp           Peer
1         eth2                           mmrp           Peer
1         eth2                           mvrp           Peer
1         eth2                           lacp           Discard
1         eth2                           lldp           Tunnel
1         eth2                           efm            Discard
1         eth2                           elmi           Tunnel
1         eth2                            ptp           Peer
```

Provider Bridging with VLAN Translation

This is a sample configurations to verify functionality to support provider-bridging feature with extended SVLAN translation as below:



Topology

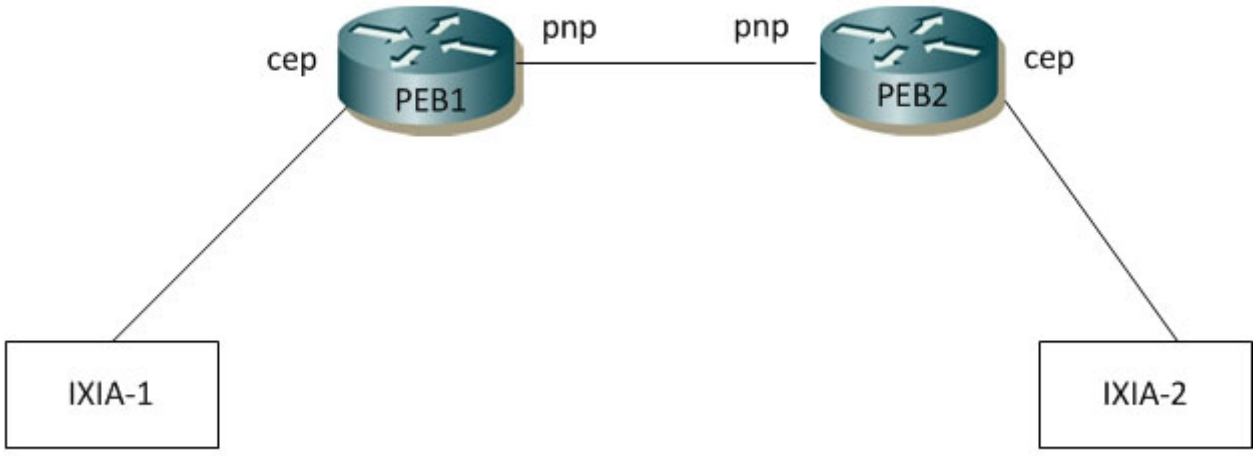


Figure 14-27: Provider Bridging with VLAN Traslation Topology

PEB1

Bridge Configuration

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol provider-rstp edge`	Enter Configure bridge type as provider-RSTP edge bridge
`(config)#exit`	Exit configure mode.

VLAN Configuration

`#configure terminal`	Enter configure mode.
`(config)#vlan database`	Enter VLAN database
`(config-vlan)# vlan 2-500 type customer bridge 1 state enable`	Configure customer VLANs on bridge 1
`(config-vlan)#vlan 501-1005 type service point-point bridge 1 state enable`	Configure service VLANs on bridge 1
`(config-vlan)#end`	Exit VLAN database and configure mode.

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 6`	Map CVLAN to SVLAN
`(config-cvlan-registration)#cvlan 3 svlan 7`	Map CVLAN to SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#bridge-group 1`	Attach port to bridge
`(config-if)#switchport mode customer-edge hybrid`	Configure port as customer-edge hybrid port
`(config-if)#switchport customer-edge hybrid allowed vlan all`	Add all VLANs configured above to this CEP port
`(config-if)#switchport customer-edge vlan registration map1`	Attach the Map1 to CEP port
`(config-if)#end`	Exit interface and configure mode.

PNP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge9`	Enter the interface mode

(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network allowed vlan all	Add all VLANs configured above to this PNP port
(config-if)#end	Exit interface and configure mode.

PEB2

Bridge Configuration

#configure terminal	Enter configure mode.
(config)# bridge 1 protocol provider-rstp edge	Enter configure bridge type as provider-RSTP edge bridge
(config)#exit	Exit configure mode.

VLAN Configuration

#configure terminal	Enter configure mode.
(config)#vlan database	Enter VLAN database
(config-vlan)#vlan 2-500 type customer bridge 1 state enable	Configure customer VLANs on bridge 1
(config-vlan)#vlan 501-1005 type service point-point bridge 1 state enable	Configure service VLANs on bridge 1
(config-vlan)#end	Exit VLAN database and configure mode.

CVLAN Registration Table Configuration

#configure terminal	Enter configure mode.
(config)#cvlan registration table map1 bridge 1	Configure CVLAN registration table as map1
(config-cvlan-registration)#cvlan 2 svlan 6	Map CVLAN to SVLAN
(config-cvlan-registration)#cvlan 3 svlan 7	Map CVLAN to SVLAN
(config-cvlan-registration)#end	End the CVLAN registration mode

CEP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface ge3	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode customer-edge hybrid	Configure port as customer-edge hybrid port
(config-if)#switchport customer-edge hybrid allowed vlan all	Add all VLANs configured above to this CEP port

(config-if)#switchport customer-edge vlan registration map1	Attach the Map1 to CEP port
(config-if)#end	Exit interface and configure mode.

PNP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface ge9	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network allowed vlan all	Add all VLANs configured above to this PNP port
(config-if)#end	Exit interface and configure mode.

Translation Cases

Case1 - (C S - C' S')

Configuration on PEB2

#configure terminal	Enter configure mode.
(config)#interface ge9	Enter the interface mode
(config-if)#switchport provider-network vlan translation cvlan 2 svlan 6 cvlan 3 svlan 7	Translate CVLAN and SVLAN to new CVLAN and new SVLAN on PNP port

Validation for Case 1

When tagged traffic with CVLAN 2 is sent from IXIA-1 to IXIA-2 with both CTAG and STAG entering provider network and gets translated to new CVLAN and SVLAN as per Case1.

```
PEB2#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address      FWD   Time-out
 --------+------+------+------+-----------+-----------------+-----+---------+
 1                1            ge27        1402.ec1c.3144    1     300
 1                6            ge9         6400.6a1e.d9a5    1     300
 1                7            ge9         0000.0500.0400    1     300
 1                7            ge9         6400.6a1e.d9a5    1     300
```

New SVLAN 7 is observed on PEB2 after translation. Also, captured packets on CEP show new CVLAN 3.

When tagged traffic for CVLAN 3 is sent from IXIA-2 to IXIA-1

```
PEB1#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address        FWD   Time-out
 --------+------+------+------+-----------+-----------------+-----+---------+
 1               1            ge9         74e6.e2af.598b    1     300
 1               6            ge3         0000.0500.0400    1     300
 1               6            ge9         0000.0500.0700    1     300
```

When traffic is reversed and traffic has both new CVLAN 3 and SVLAN 7 on provider network from IXIA-2, translation to old CVLAN 2 and SVLAN 6 happens. Also, captured packets have CVLAN as 2.

Case2 - (C S - S')

Configuration on PEB2

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 6`	Map CVLAN to SVLAN
`(config-cvlan-registration)#cvlan 3 svlan 7 untagged-pep`	Map CVLAN to SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport customer-edge hybrid vlan 3`	Allow access VLAN 3 configured above to this CEP port
`(config-if)#switchport customer-edge hybrid allowed vlan add 2-3`	Allow other VLANs configured to this CEP port
`(config-if)#switchport customer-edge vlan registration map1`	Attach the Map1 to CEP port
`(config-if)#end`	Exit interface and configure mode.

PNP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge9`	Enter the interface mode
`(config-if)#no switchport provider-network vlan translation cvlan 2 svlan 6`	Unconfigure Translation Case1 from PNP port
`(config-if)#switchport provider-network vlan translation cvlan 2 svlan 6 svlan 7`	Configure Translation Case2 on PNP port
`(config-if)#end`	Exit interface and configure mode.

Validation for Case 2

When tagged traffic with CVLAN 2 is sent from IXIA-1 to IXIA-2 with both CTAG and STAG entering provider network and translated to new SVLAN as per Case2.

```
PEB2#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1                 1             ge27        1402.ec1c.3144    1     300
 1                 7             ge9         0000.0500.0400    1     300
```

New SVLAN 7 is observed on PEB2 after translation. At CEP port connected to IXIA-2, untagged traffic should be received.

When tagged traffic for CVLAN 3 is sent from IXIA-2 to IXIA-1.

```
PEB1#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 --------+------+------+------+-----------+------------------+-----+---------+
 1               1             ge9          74e6.e2af.598b    1     300
 1               6             ge3          0000.0500.0400    1     300
 1               6             ge9          0000.0500.0700    1     300
```

When traffic is reversed and traffic has both new CVLAN 3 and SVLAN 7 from IXIA-2, translatiom to old CVLAN 2 and SVLAN 6 happens. Also, captured packets have CVLAN as 2.

Case3 - (S - S')

Configuration on PEB1

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 6`	Map CVLAN to SVLAN
`(config-cvlan-registration)#cvlan 3 svlan 7`	Map CVLAN to SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport customer-edge hybrid vlan 2`	Allow access VLAN 2 configured above to this CEP port
`(config-if)#switchport customer-edge hybrid allowed vlan add 2-3`	Allow other VLANs configured to this CEP port
`(config-if)#switchport customer-edge vlan registration map1`	Attach the Map1 to CEP port
`(config-if)#end`	Exit interface and configure mode.

Configuration on PEB2

CEP Port Configuration (should be configured as PNP in this case)

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#switchport mode provider-network`	Configure port as Provider Network Port (PNP)
`(config-if)#switchport provider-network allowed vlan all`	Add all VLANs configured above to this PNP port
`(config-if)#end`	Exit interface and configure mode.

PNP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge9`	Enter the interface mode
`(config-if)#no switchport provider-network vlan translation cvlan 2 svlan 6`	Unconfigure Translation Case2 from PNP port
`(config-if)#switchport provider-network vlan translation svlan 6 svlan 7`	Configure Translation Case3 on PNP port
`(config-if)#end`	Exit interface and configure mode.

Validation for Case 3

When tagged traffic with CVLAN 2 is sent from IXIA-1 to IXIA-2 with only STAG entering provider network and translation happens to new SVLAN as per Case3.

```
PEB2#show bridge
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1               1             ge27         1402.ec1c.3144    1     300
 1               6             ge9          0000.0500.0400    1     300
 1               6             ge9          6400.6a1e.d9a5    1     300
```

New SVLAN 7 is observed on PEB2 At PNP port connected to IXIA-2.

When double tagged traffic of CVLAN 2 and SVLAN 7 is sent from IXIA-2 to IXIA-1:

```
PEB1#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1               1             ge9          74e6.e2af.598b    1     300
 1               7             ge3          0000.0500.0400    1     300
 1               6             ge9          0000.0500.0700    1     300
```

Here we get a tagged traffic of CVALN 2 when the captured at IXIA-1.

Case4 - (S - C' S')

Configuration on PEB1

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 6 untagged-pep`	Map CVLAN to SVLAN
`(config-cvlan-registration)#cvlan 3 svlan 7`	Map CVLAN to SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode

`(config-if)#switchport customer-edge hybrid vlan 2`	Allow access VLAN 2 configured above to this CEP port
`(config-if)#switchport customer-edge hybrid allowed vlan add 2-3`	Allow other VLANs configured to this CEP port
`(config-if)#switchport customer-edge vlan registration map1`	Attach the Map1 to CEP port
`(config-if)#end`	Exit interface and configure mode.

Configuration on PEB2

CEP Port Configuration (should be configured as PNP in this case)

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#bridge-group 1`	Attach port to bridge
`(config-if)#switchport mode provider-network`	Configure port as Provider Network Port (PNP)
`(config-if)#switchport provider-network allowed vlan all`	Add all VLANs configured above to this PNP port
`(config-if)#end`	Exit interface and configure mode.

PNP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge9`	Enter the interface mode
`(config-if)#no switchport provider-network vlan translation svlan 6 svlan 7`	Unconfigure Translation Case2 from PNP port
`(config-if)#switchport provider-network vlan translation svlan 6 cvlan 3 svlan 7`	Configure Translation Case3 on PNP port
`(config-if)#end`	Exit interface and configure mode.

Validation for Case 4

When tagged traffic with CVLAN 2 is sent from IXIA-1 to IXIA-2 enters provider network and translation happens to new CVLAN and new SVLAN as per Case4.

```
PEB2#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1               1             ge27        1402.ec1c.3144    1     300
 1               6             ge9         0000.0500.0400    1     300
 1               6             ge9         6400.6a1e.d9a5    1     300
```

When you observe the traffic received in IXIA-2, you can observe that new CVLAN 3 and SVLAN 7 tags can be seen. Here the VLAN 2 will be a data packet.

When tagged traffic for CVLAN 3 and SVLAN 7 is sent from IXIA-2 to IXIA-1:

```
PEB1#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port        MAC Address       FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
```



```
1               6               ge3          0000.0500.0400    1      300
1               7               ge9          0000.0500.0700    1      300
```

When you observe, in PEB1 the packets will be dropped at the CEP port since only a single S tagged packets is obtained in the PNP.

Case5 - (C - C' S')

Configuration on PEB1

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 cvlan3 svlan 4`	Map CVLAN to C'VLAN and SVLAN
`(config-cvlan-registration)#cvlan 5 cvlan 6 svlan 7`	Map CVLAN to C'VLAN and SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#bridge-group 1`	Attach port to bridge
`(config-if)#switchport mode customer-edge hybrid`	Configure port as customer-edge hybrid port
`(config-if)#switchport customer-edge hybrid allowed vlan all`	Allow other VLANs configured to this CEP port
`(config-if)#switchport customer-edge vlan registration map1`	Attach the Map1 to CEP port
`(config-if)#end`	Exit interface and configure mode.

Configuration on PEB2

CEP Port Configuration (should be configured as PNP in this case)

`#configure terminal`	Enter configure mode.
`(config)#interface ge3`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#bridge-group 1`	Attach port to bridge
`(config-if)#switchport mode provider-network`	Configure port as Provider Network Port (PNP)
`(config-if)#switchport provider-network allowed vlan all`	Add all VLANs configured above to this PNP port
`(config-if)#end`	Exit interface and configure mode.

PNP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface ge9`	Enter the interface mode
`(config-if)#switchport`	Configure switchport
`(config-if)#bridge-group 1`	Attach port to bridge
`(config-if)#switchport mode provider-network`	Configure port as Provider Network Port (PNP)
`(config-if)#switchport provider-network allowed vlan all`	Add all VLANs configured above to this PNP port
`(config-if)#end`	Exit interface and configure mode.

Validation for Case 5

When tagged traffic with CVLAN 2 is sent from IXIA-1 to IXIA-2 with both CTAG and STAG entering provider network and gets translated to new CVLAN and SVLAN as per Case1.

```
PEB2#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1               1              ge27         1402.ec1c.3144     1     300
 1               6              ge9          0000.0500.0400     1     300
 1               6              ge9          6400.6a1e.d9a5     1     300
```

When the packet is captured at PNP port of PEB2 CVLAN of 3 and SVLAN of 4 is seen.

When tagged traffic for CVLAN 6 and SVLAN 7 is sent from IXIA-2 to IXIA-1:

```
PEB1#show bridge
Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+------------------+-----+---------+
 1               1              ge9          74e6.e2af.598b     1     300
 1               4              ge3          0000.0500.0400     1     300
 1               7              ge9          0000.0500.0700     1     300
```

When traffic is reversed and traffic has both new CVLAN 6 and SVLAN 7 on provider network from IXIA-2, translation to CVLAN 5 and SVLAN 7 happens. Also, captured packets have CVLAN as 2 based on the entry in the cvlan registration table.

Switchport ethertype

Bridge Configuration (for 0x88a8)

Configuration on PEB1

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 4`	Map CVLAN to SVLAN

(config-cvlan-registration)#cvlan 3 svlan 6	Map CVLAN to SVLAN
(config-cvlan-registration)#end	End the CVLAN registration mode

Configuration on PEB2

CEP Port Configuration (should be configured as PNP in this case)

CEP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface ge3	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network allowed vlan all	Add all VLANs configured above to this PNP port
(config-if)#end	Exit interface and configure mode.

PNP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface ge9	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network vlan allowed vlan all	Add all VLANs configured above to this PNP port
(config-if)#switchport dot1q ethertype 0x88a8	Change the TPID of the SVLAN to 0x88a8
(config-if)#end	Exit interface and configure mode.

Validation for Switchport ethertype

To validate, send tagged traffic of VLAN 2 from IXIA-1.

Now at eth9 of PB2, capture the packets through IXIA-2 and verify that the traffic is received with double tag.

If the 2 tags CVLAN tag 2 will have the TPID of 0x8100 and SVLAN tag 4 will have a TPID of 0x88a8.

Provider Bridging QoS Configuration

This chapter contains sample provider bridging configurations for QoS.

Scenario: 1 Traffic flow from CEP to PNP

Topology

Figure 14-28: Provider Bridging with QoS Topology

Bridge Configuration

`#configure terminal`	Enter configure mode.
`(config)# bridge 1 protocol provider-rstp edge`	Enter configure bridge type as provider-RSTP edge bridge
`(config)#exit`	Exit configure mode.

VLAN Configuration

`#configure terminal`	Enter configure mode.
`(config)#vlan database`	Enter VLAN database
`(config-vlan)#vlan 2-500 type customer bridge 1 state enable`	Configure customer VLANs on bridge 1
`(config-vlan)#vlan 501-1005 type service point-point bridge 1 state enable`	Configure service VLANs on bridge 1
`(config-vlan)#end`	Exit VLAN database and configure mode.

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#cvlan 2 svlan 501`	Map CVLAN to SVLAN
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface xe2`	Enter the interface mode

(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode customer-edge hybrid	Configure port as customer-edge hybrid port
(config-if)#switchport customer-edge hybrid allowed vlan all	Add all VLANs configured above to this CEP port
(config-if)#switchport customer-edge vlan registration map1	Attach the Map1 to CEP port
(config-if)#end	Exit interface and configure mode.

PNP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface xe3	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network allowed vlan add 501	Add all VLANs configured above to this PNP port
(config-if)#end	Exit interface and configure mode.

QoS Configurations

#configure terminal	Enter configure mode.
(config)#hardware-profile filter qos-ext enable	Enabling Ingress extended QoS group for QoS support with statistics
(config-if)#qos enable	Enabling QoS
(config-if)#qos statistics	Enabling QoS statistics
(config-if)#qos profile cos-to-queue cosq-cust1	Configure QoS map profile
config-ingress-cos-map)#cos 0 queue 1	Configuring the cos value to be mapped to queue
(config-ingress-cos-map)#exit	Exit configure mode.
(config)#qos profile queue-color-to-cos cosq-service1	Configuring profile for queue color to cos map
(config-egress-cos-map)#queue 1 cos 3	Configuring the queue value to be cos remarked.
(config-egress-cos-map)#exit	Exit configure mode
(config)#cvlan registration table map1 bridge 1	Enter CVLAN registration mode
(config-cvlan-registration)#cvlan 2 svlan 501 cos-to-queue cosq-cust1	Map CVLAN to SVLAN with QoS map profile. Eg: when vlan 2 customer traffic with cos 0 value is received, queue will be assigned to 1 based on mapping.
(config-cvlan-registration)#end	End the CVLAN registration mode
(config)#interface xe3	Enter the interface mode
(config-if)#qos map-profile queue-color-to-cos cosq-service1	Map the profile to the PNP port. Eg: when traffic goes out of queue 1, cos value on service vlan header will be modified to 3 as remarking is enabled on the interface.

(config-if)#qos remark cos enable	Enabling Cos Remark on the Network Interface.
(config-if)#end	Exit interface and configure mode.

Validation for Scenario 1

```
#show cvlan registration table map1
Bridge          Table Name       Port List
======          ==========       =========
1               map1             xe2

CVLAN ID        T-CVLAN ID      SVLAN ID        Profile Name    Egress remark-
Cos
========        ==========      ========        ============
=================
2               -               501             cosq-cust1      No

#show qos-profile interface xe2
profile name: default
 profile type: cos-to-queue (Ingress)
 mapping:
 ---------------+----------------- | ---------------+-----------------
      INPUT     |     OUTPUT       |      INPUT     |     OUTPUT
 ---------------+----------------- | ---------------+-----------------
   COS   |  DEI   | Queue |  Color   |   COS   |  DEI   | Queue |  Color
 -------+-------+-------+--------- | -------+-------+-------+---------
  0       0       0       green    |  0       1       0       yellow
  1       0       1       green    |  1       1       1       yellow
  2       0       2       green    |  2       1       2       yellow
  3       0       3       green    |  3       1       3       yellow
  4       0       4       green    |  4       1       4       yellow
  5       0       5       green    |  5       1       5       yellow
  6       0       6       green    |  6       1       6       yellow
  7       0       7       green    |  7       1       7       yellow

profile name: default
 profile type: queue-color-to-cos (Egress)
 Status: Inactive
mapping:
 ----------------+-------- | ----------------+-------- | ----------------+----
----
      INPUT      | OUTPUT  |      INPUT      | OUTPUT  |      INPUT      |
OUTPUT
 ----------------+-------- | ----------------+-------- | ----------------+----
----
  Queue | Color  | COS     |  Queue | Color  | COS     |  Queue | Color  | COS
 -------+--------+-------- | -------+--------+-------- | -------+--------+----
----
  0       green    0       |  0       yellow   0       |  0       red      0
  1       green    1       |  1       yellow   1       |  1       red      1
  2       green    2       |  2       yellow   2       |  2       red      2
  3       green    3       |  3       yellow   3       |  3       red      3
  4       green    4       |  4       yellow   4       |  4       red      4
  5       green    5       |  5       yellow   5       |  5       red      5
  6       green    6       |  6       yellow   6       |  6       red      6
  7       green    7       |  7       yellow   7       |  7       red      7
```

```
#show qos-profile interface xe3
profile name: default
 profile type: cos-to-queue (Ingress)
 mapping:
 ---------------+----------------- | ---------------+-----------------
      INPUT     |     OUTPUT       |      INPUT     |     OUTPUT
 ---------------+----------------- | ---------------+-----------------
   COS  |  DEI  | Queue |  Color   |   COS  |  DEI  | Queue |  Color
 -------+-------+-------+--------- | -------+-------+-------+---------
  0       0       0       green    |  0       1       0       yellow
  1       0       1       green    |  1       1       1       yellow
  2       0       2       green    |  2       1       2       yellow
  3       0       3       green    |  3       1       3       yellow
  4       0       4       green    |  4       1       4       yellow
  5       0       5       green    |  5       1       5       yellow
  6       0       6       green    |  6       1       6       yellow
  7       0       7       green    |  7       1       7       yellow

profile name: cosq-service1
 profile type: queue-color-to-cos (Egress)
 Status: Active
mapping:
 ----------------+-------- | ----------------+-------- | ----------------+----
----
      INPUT      | OUTPUT  |       INPUT      | OUTPUT  |       INPUT      |
OUTPUT
 ----------------+-------- | ----------------+-------- | ----------------+----
----
  Queue | Color  | COS     |  Queue | Color  | COS     |  Queue | Color  | COS
 -------+--------+-------- | -------+--------+-------- | -------+--------+----
----
  0       green    0       |  0       yellow   0       |  0       red      0
  1       green    3       |  1       yellow   3       |  1       red      3
  2       green    2       |  2       yellow   2       |  2       red      2
  3       green    3       |  3       yellow   3       |  3       red      3
  4       green    4       |  4       yellow   4       |  4       red      4
  5       green    5       |  5       yellow   5       |  5       red      5
  6       green    6       |  6       yellow   6       |  6       red      6
  7       green    7       |  7       yellow   7       |  7       red      7
```

Scenario: 2 Traffic flow from PNP to CEP

Topology

Figure 14-29: Provider Bridging with QoS Topology

Bridge Configuration

`#configure terminal`	Enter configure mode.
`(config)# bridge 1 protocol provider-rstp edge`	Enter configure bridge type as provider-RSTP edge bridge
`(config)#exit`	Exit configure mode.

VLAN Configuration

`#configure terminal`	Enter configure mode.
`(config)#vlan database`	Enter VLAN database
`(config-vlan)#vlan 2-500 type customer bridge 1 state enable`	Configure customer VLANs on bridge 1
`(config-vlan)#vlan 501-1005 type service point-point bridge 1 state enable`	Configure service VLANs on bridge 1
`(config-vlan)#end`	Exit VLAN database and configure mode.

CVLAN Registration Table Configuration

`#configure terminal`	Enter configure mode.
`(config)#cvlan registration table map1 bridge 1`	Configure CVLAN registration table as map1
`(config-cvlan-registration)#end`	End the CVLAN registration mode

CEP Port Configuration

`#configure terminal`	Enter configure mode.
`(config)#interface xe2`	Enter the interface mode

(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode customer-edge hybrid	Configure port as customer-edge hybrid port
(config-if)#switchport customer-edge hybrid allowed vlan all	Add all VLANs configured above to this CEP port
(config-if)#switchport customer-edge vlan registration map1	Attach the Map1 to CEP port
(config-if)#end	Exit interface and configure mode.

PNP Port Configuration

#configure terminal	Enter configure mode.
(config)#interface xe3	Enter the interface mode
(config-if)#switchport	Configure switchport
(config-if)#bridge-group 1	Attach port to bridge
(config-if)#switchport mode provider-network	Configure port as Provider Network Port (PNP)
(config-if)#switchport provider-network allowed vlan add 501	Add all VLANs configured above to this PNP port
(config-if)#end	Exit interface and configure mode.

QoS Configurations

#configure terminal	Enter configure mode.
(config)#hardware-profile filter qos-ext enable	Enabling Ingress extended QoS group for QoS support with statistics
(config-if)#qos enable	Enabling QoS
(config-if)#qos statistics	Enabling QoS statistics
(config-if)#qos profile cos-to-queue cosq-cust1	Configure QoS map profile
config-ingress-cos-map)#cos 2 queue 5	Configuring the cos value to be mapped to queue. Eg: when double tagged traffic with cos 2 for outer vlan is received, queue will be assigned to 5 based on mapping.
(config-ingress-cos-map)#exit	Exit configure mode.
(config)#cvlan registration table map1 bridge 1	Enter CVLAN registration mode
(config-cvlan-registration)#cvlan 2 svlan 501 remark-cos	Map CVLAN to SVLAN with remark cos enabled. Eg: when double tagged traffic with cos 2 for outer vlan is received, queue will be assigned to 5 based on mapping and cos value will be changed to 5 when it goes out of cep port since remark cos is enabled.
(config-cvlan-registration)#cvlan 3 svlan 501 remark-cos	Map CVLAN to SVLAN without remark cos. Eg: when double tagged traffic with cos 2 for outer vlan is received, and cos value will be forwarded as it is when it goes out of cep port since remark cos is not enabled for customer2.
(config-cvlan-registration)#end	End the CVLAN registration mode
(config)#configure terminal	Enter configure mode

(config)#interface xe3	Enter the interface mode
(config-if)#qos map-profile cos-to-queue cosq-service	Map the profile to the PNP port
(config-if)#end	Exit interface and configure mode

Validation for Scenario 2

```
#show cvlan registration table map1
Bridge          Table Name       Port List
======          ==========       =========
1               map1             xe2

CVLAN ID        T-CVLAN ID      SVLAN ID        Profile Name    Egress remark-
Cos
========        ==========      ========        ============
=================
2               -               501             N/A             Yes
3               -               501             N/A             No

#show qos-profile interface xe2
profile name: default
 profile type: cos-to-queue (Ingress)
 mapping:
 ---------------+----------------- | ---------------+-----------------
      INPUT     |     OUTPUT       |      INPUT     |     OUTPUT
 ---------------+----------------- | ---------------+-----------------
   COS  |  DEI  | Queue |  Color   |   COS  |  DEI  | Queue |  Color
 -------+-------+-------+--------- | -------+-------+-------+---------
  0       0       0       green    |  0       1       0       yellow
  1       0       1       green    |  1       1       1       yellow
  2       0       2       green    |  2       1       2       yellow
  3       0       3       green    |  3       1       3       yellow
  4       0       4       green    |  4       1       4       yellow
  5       0       5       green    |  5       1       5       yellow
  6       0       6       green    |  6       1       6       yellow
  7       0       7       green    |  7       1       7       yellow

profile name: default
 profile type: queue-color-to-cos (Egress)
 Status: Inactive
mapping:
 ----------------+-------- | ----------------+-------- | ----------------+----
----
      INPUT      | OUTPUT  |      INPUT      | OUTPUT  |      INPUT      |
OUTPUT
 ----------------+-------- | ----------------+-------- | ----------------+----
----
  Queue | Color  | COS     |  Queue | Color  | COS     |  Queue | Color  | COS
 -------+--------+-------- | -------+--------+-------- | -------+--------+----
----
  0       green    0       |  0       yellow   0       |  0       red      0
  1       green    1       |  1       yellow   1       |  1       red      1
  2       green    2       |  2       yellow   2       |  2       red      2
  3       green    3       |  3       yellow   3       |  3       red      3
  4       green    4       |  4       yellow   4       |  4       red      4
  5       green    5       |  5       yellow   5       |  5       red      5
```

```
  6       green    6       |  6       yellow   6       |  6       red      6
  7       green    7       |  7       yellow   7       |  7       red      7

#show qos-profile interface xe3
profile name: cosq-service
 profile type: cos-to-queue (Ingress)
 mapping:
 ---------------+----------------- | ---------------+-----------------
      INPUT     |     OUTPUT       |      INPUT     |     OUTPUT
 ---------------+----------------- | ---------------+-----------------
   COS  |  DEI  | Queue |  Color   |   COS  |  DEI  | Queue |  Color
 -------+-------+-------+--------- | -------+-------+-------+---------
  0       0       0       green    |  0       1       0       yellow
  1       0       1       green    |  1       1       1       yellow
  2       0       5       green    |  2       1       5       yellow
  3       0       3       green    |  3       1       3       yellow
  4       0       4       green    |  4       1       4       yellow
  5       0       5       green    |  5       1       5       yellow
  6       0       6       green    |  6       1       6       yellow
  7       0       7       green    |  7       1       7       yellow

profile name: default
 profile type: queue-color-to-cos (Egress)
 Status: Inactive
mapping:
 ----------------+-------- | ----------------+-------- | ----------------+----
----
      INPUT      | OUTPUT  |       INPUT      | OUTPUT  |       INPUT      |
OUTPUT
 ----------------+-------- | ----------------+-------- | ----------------+----
----
  Queue | Color  | COS     |  Queue | Color  | COS     |  Queue | Color  | COS
 -------+--------+-------- | -------+--------+-------- | -------+--------+----
----
  0       green    0       |  0       yellow   0       |  0       red      0
  1       green    1       |  1       yellow   1       |  1       red      1
  2       green    2       |  2       yellow   2       |  2       red      2
  3       green    3       |  3       yellow   3       |  3       red      3
  4       green    4       |  4       yellow   4       |  4       red      4
  5       green    5       |  5       yellow   5       |  5       red      5
  6       green    6       |  6       yellow   6       |  6       red      6
  7       green    7       |  7       yellow   7       |  7       red      7
```

Provider Bridging Untagged-pep Configuration

This is a sample configuration to verify functionality to support provider-bridging with untagged-pep feature.

For the below topology configuration,

1. While sending tagged traffic untagged-pep CVLAN 2, it should drop in provider edge bridge.
2. And while sending tagged traffic CVLAN 3 to the provider network, will egress with CVLAN 3 and SVLAN 12 tag and the same CVLAN and SVLAN tag from provider network, will egress with only CVLAN tag
3. And also for untagged traffic to the provider network, will egress with SVLAN 11 tag

Topology

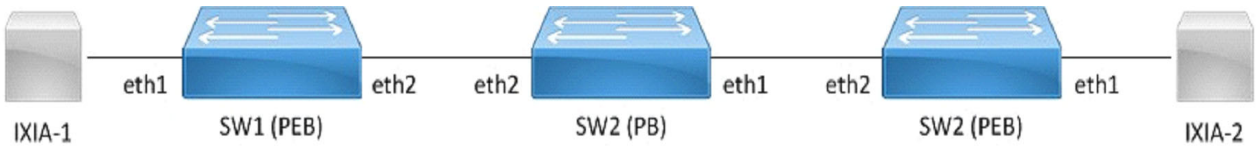


Figure 14-30: provider bridge untagged-pep configuration

Configuration

SW1 (PEB)

`SW1#configure terminal`	Enter configuration mode
`SW1(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW1(config)#vlan database`	Enter VLAN configuration mode
`SW1(config-vlan)#vlan 2-10 type customer bridge 1 state enable`	Create customer vlan VLAN 2-10
`SW1(config-vlan)#vlan 11-15 type service point-point bridge 1 state enable`	Create service vlan VLAN 11-15
`SW1(config-vlan)#exit`	Exit VLAN configuration mode
`SW1(config)#cvlan registration table map1 bridge 1`	Create cvlan registration table map1
`SW1(config-cvlan-registration)#cvlan 2 svlan`	
`11 untagged-pep`	Map cvlan2 with svlan 11
`SW1(config-cvlan-registration)#cvlan 3 svlan`	
`12`	Map cvlan3 with svlan 12
`SW1(config-cvlan-registration)#cvlan 4 svlan`	
`14`	Map cvlan4 with svlan 14
`SW1(config-cvlan-registration)#exit`	Exit registration table
`SW1(config)#interface eth1`	Enter interface configuration mode for eth1
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode customer-edge access`	Configure switchport mode customer edge
`SW1(config-if)#switchport customer-edge hybrid vlan 2`	Associate customer vlan2 with interface
`SW1(config-if)#switchport customer-edge hybrid allowed vlan all`	Associate all customer vlan with interface
`SW1(config-if)#switchport customer-edge vlan registration map1`	Attach registration table map1 with interface
`SW1(config-if)#exit`	Exit interface mode
`SW1(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW1(config-if)#switchport`	Make interface as switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW1(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW1(config-if)#exit`	Exit interface configuration mode
`SW1(config)#commit`	Apply the commit
`SW1(config)#end`	Exit configuration mode

SW2 (PB)

SW2#configure terminal	Enter configuration mode
SW2(config)#bridge 1 protocol provider-rstp	Create provider bridge
SW2(config)#vlan database	Enter VLAN configuration mode
SW2(config-vlan)# vlan 2-15 type service point-point bridge 1 state enable	Create service vlan VLAN2-15
SW2(config-vlan)#exit	Exit VLAN configuration mode
SW2(config)#interface eth1	Enter interface configuration mode for eth1
SW2(config-if)#switchport	Make interface as switchport
SW2(config-if)#bridge-group 1	Associate interface with bridge-group 1
SW2(config-if)#switchport mode provider-network	Configure switchport pnp port
SW2(config-if)#switchport provider-network allowed vlan all	Associate all svlan to the port
SW2(config-if)#exit	Exit interface configuration mode
SW2(config-if)#interface eth2	Enter interface configuration mode for eth2
SW2(config-if)#switchport	Make interface as switchport
SW2(config-if)#bridge-group 1	Associate interface with bridge-group 1
SW2(config-if)#switchport mode provider-network	Configure switchport pnp port
SW2(config-if)#switchport provider-network allowed vlan all	Associate all svlan to the port
SW2(config-if)#exit	Exit interface configuration mode
SW2(config)#commit	Apply the commit
SW2(config)#end	Exit configuration mode

SW3 (PEB)

SW3#configure terminal	Enter configuration mode
SW3(config)#bridge 1 protocol provider-rstp edge	Create bridge
SW3(config)#vlan database	Enter VLAN configuration mode
SW3(config-vlan)#vlan 2-10 type customer bridge 1 state enable	Create customer vlan VLAN 2-10
SW3(config-vlan)#vlan 11-15 type service point-point bridge 1 state enable	Create service vlan VLAN11-15
SW3(config-vlan)#exit	Exit VLAN configuration mode
SW3(config)#cvlan registration table map1 bridge 1	Create cvlan registration table map1
SW3(config-cvlan-registration)#cvlan 2 svlan	
11 untagged-pep	Map cvlan2 with svlan 200
SW3(config-cvlan-registration)#cvlan 3 svlan	
12	Map cvlan3 with svlan 12
SW3(config-cvlan-registration)#cvlan 4 svlan	
14	Map cvlan4 with svlan 14

SW3(config-cvlan-registration)#exit	Exit registration table
SW3(config)#interface eth1	Enter interface configuration mode for eth1
SW3(config-if)#switchport	Configure switchport
SW3(config-if)#bridge-group 1	Associate interface with bridge-group 1
SW3(config-if)#switchport mode customer-edge access	Configure switchport mode customer edge
SW3(config-if)#switchport customer-edge hybrid vlan 2	Associate customer vlan2 with interface
SW3(config-if)#switchport customer-edge hybrid allowed vlan all	Associate all customer vlan with interface
SW3(config-if)#switchport customer-edge vlan registration map1	Attach registration table map1 with interface
SW3(config-if)#exit	Exit interface mode
SW3(config-if)#interface eth2	Enter interface configuration mode for eth2
SW3(config-if)#switchport	Make interface as switchport
SW3(config-if)#bridge-group 1	Associate interface with bridge-group 1
SW3(config-if)#switchport mode provider-network	Configure switchport pnp port
SW3(config-if)#switchport provider-network allowed vlan all	Associate all svlan to the port
SW3(config-if)#exit	Exit interface configuration mode
SW3(config)#commit	Apply the commit
SW3(config)#end	Exit configuration mode

Validation

```
SW3#sh bridge
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1         4      14             eth2          0000.0100.0007    1     300

SW1#sh bridge
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be a
ffected here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 ---------+------+------+------+-----------+-----------------+-----+---------+
 1                14             eth1        0000.0100.0007    1     300
```

```
SW1#sh cvlan registration table map1
Bridge          Table Name       Port List

======          ==========       =========

1               map1             eth1

CVLAN ID        T-CVLAN ID      SVLAN ID        CCOS  SCOS  CCFI  SCFI
========        ==========      ========        ====  ====  ====  ====
3               -               12
2               -               11
4               -               14
```

CHAPTER 15 Provider Bridging Configuration (SVLAN)

This chapter contains sample provider bridging configurations for Customer-Network Port (CNP).

A provider bridged network is a virtual bridged Local Area Network that comprises provider bridges (SVLAN bridges and provider edge bridges) and attached LANs, under the administrative control of a single service provider. Provider bridges interconnect the separate MACs of the IEEE 802 LANs that compose a provider bridged network, relaying frames to provide connectivity between all the LANs that provide customer interfaces for each service instance.

Customer-Network Port (CNP)

In Q-in-Q, the customer network port is similar to provider network port, which can be present in provider-edge bridge (PEB) or provider bridge core (PB), where it can be directly connected to a dedicated customer network. Only SVLAN ids are configurable on Customer network port and learning and forwarding occurs based on SVLAN.

STAG-based Interface

In this case, the customer will be sending traffic with SVLAN, which will be learnt and forwarded via provider network.

In this example, the xe1 interface allows S-TAG 100-200 and 400 traffic from customer.

```
(config)#interface xe1
(config-if)#switchport
(config-if)#dot1ad ethertype 0x88a8
(config-if)#bridge-group 1
(config-if)#switchport mode customer-network
(config-if)#switchport customer-network allowed vlan add 100-200,400
```

Port-based Interface

In this case, the customer traffic with C-VLAN/untagged, received on interface will be stacked with a customer-network SVLAN ID and will be forwarded via provider network. While egressing out of customer-network port for the default SVLAN, the outer SVLAN id will be stripped and the packet will be sent as C-TAG or untagged to customer device.

In this example, the xe1 interface allows C-TAG/untagged traffic from customers, adding an SVLAN ID 100 before forwarding to the provider network. While egressing out, the SVLAN ID100 will be stripped.

```
(config)#interface xe1
(config-if)#switchport
(config-if)#dot1ad ethertype 0x88a8
(config-if)#bridge-group 1
(config-if)#switchport mode customer-network
(config-if)#switchport customer-network allowed vlan add 100
(config-if)#switchport customer-network vlan 100
```

Topology

Figure 15-31: Single provider bridge configuration

Configuration

SW1 (PEB)

`SW1#configure terminal`	Enter configuration mode
`SW1(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW1(config)#vlan database`	Enter VLAN configuration mode
`SW1(config-vlan)#vlan 100,200 type service point-point bridge 1 state enable`	Create service vlan VLAN 100, 200
`SW1(config-vlan)#exit`	Exit VLAN configuration mode
`SW1(config)#interface eth1`	Enter interface configuration mode for eth1
`SW1(config-if)#switchport`	Configure switchport
`SW1(config-if)#dot1ad ethertype 0x88a8`	Add Provider Bridging Service VLAN tag identifier
`SW1(config-if)#switchport mode customer-network`	Configure switchport mode for CNP(customer network port)
`SW1(config-if)#switchport customer-network allowed vlan add 200`	Associate vlan 200 with interface
`SW1(config-if)#switchport customer-network vlan 200`	Add vlan 200 as default SVLAN-ID for traffic with CVLAN/ untagged
`SW1(config-if)#exit`	Exit interface mode
`SW1(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW1(config-if)#switchport`	Make interface as switchport
`SW1(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW1(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW1(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW1(config-if)#commit`	Commit the configuration.
`SW1(config-if)#exit`	Exit interface configuration mode

SW2 (PB)

`SW2#configure terminal`	Enter configuration mode
`SW2(config)#bridge 1 protocol provider-rstp`	Create provider bridge
`SW2(config)#vlan database`	Enter VLAN configuration mode
`SW2(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW2(config-vlan)#exit`	Exit VLAN configuration mode
`SW2(config)#interface eth1`	Enter interface configuration mode for eth1
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#exit`	Exit interface configuration mode
`SW2(config-if)#interface eth2`	Enter interface configuration mode for eth2
`SW2(config-if)#switchport`	Make interface as switchport
`SW2(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW2(config-if)#switchport mode provider-network`	Configure switchport pnp port
`SW2(config-if)#switchport provider-network allowed vlan all`	Associate all svlan to the port
`SW2(config-if)#commit`	Commit the configuration.
`SW2(config-if)#exit`	Exit interface configuration mode

SW3 (PEB)

`SW3#configure terminal`	Enter configuration mode
`SW3(config)#bridge 1 protocol provider-rstp edge`	Create bridge
`SW3(config)#vlan database`	Enter VLAN configuration mode
`SW3(config-vlan)#vlan 200 type service point-point bridge 1 state enable`	Create service vlan VLAN200
`SW3(config-vlan)#exit`	Exit VLAN configuration mode
`SW3(config)#interface eth1`	Enter interface configuration mode for eth1
`SW3(config-if)#switchport`	Configure switchport
`SW3(config-if)#dot1ad ethertype 0x88a8`	Add Provider Bridging Service VLAN tag identifier
`SW3(config-if)#bridge-group 1`	Associate interface with bridge-group 1
`SW3(config-if)#switchport mode customer-network`	Configure switchport CNP port
`SW3(config-if)#switchport customer-network allowed vlan add 200`	Associate vlan 200 with interface
`SW3(config-if)#switchport customer-network vlan 200`	Add vlan 200 as default SVLAN-ID for traffic with CVLAN/ untagged

SW3(config-if)#exit	Exit interface mode
SW3(config-if)#interface eth2	Enter interface configuration mode for eth2
SW3(config-if)#switchport	Make interface as switchport
SW3(config-if)#bridge-group 1	Associate interface with bridge-group 1
SW3(config-if)#switchport mode provider-network	Configure switchport pnp port
SW3(config-if)#switchport provider-network allowed vlan all	Associate all svlan to the port
SW3(config-if)#commit	Commit the configuration.
SW3(config-if)#exit	Exit interface configuration mode

Validation

```
SW3#show bridge
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
Bridge    CVLAN  SVLAN  BVLAN     Port       MAC Address    FWD   Time-out
---------+------+------+------+----------+-----------------+-----+------+
     1             200            eth1      0000.0000.0f00    1     300
     1             200            eth2      0001.0000.0800    1     300

SW1#show bridge
bridge 1 is running on provider-rstp edge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
Bridge    CVLAN  SVLAN  BVLAN     Port       MAC Address    FWD   Time-out
---------+------+------+------+----------+-----------------+-----+------+
     1             200            eth2      0000.0000.0f00    1     300
     1             200            eth1      0001.0000.0800    1     300
```

CHAPTER 16 Link Layer Discovery Protocol Configuration

This chapter contains a complete sample Link Layer Discovery Protocol (LLDP) configuration.

LLDP is a neighbor discovery protocol that defines a method for network access devices using Ethernet connectivity to advertise themselves to other devices on the same physical LAN, and then to store information about the network. It allows a device to learn higher-layer management reachability and connection endpoint information from adjacent devices. Using LLDP, a network device is able to advertise its identity, its capabilities and its media-specific configuration, as well as learn the same information from other connected devices.

Note: The `lldp-agent` command is not supported for SVLAN, VLAN, and loop-back interfaces.

Topology

Figure 16-32 displays a sample LLDP topology.

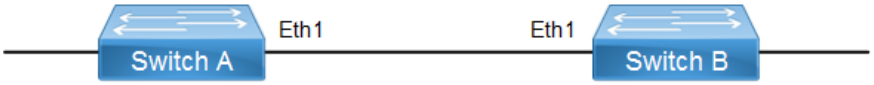


Figure 16-32: LLDP Topology

Interface Mode TLV

Default Agent

All configuration commands in the table below should be followed for each switch.

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol ieee vlan-bridge`	Configure an IEEE VLAN-aware bridge.
`(config)#vlan database`	Enter VLAN configure mode.
`(config-vlan)#vlan 2 bridge 1 state enable`	Configure a VLAN and add it to the bridge.
`(config-vlan)#exit`	Exit the VLAN configuration mode.
`(config)#interface eth1`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#bridge-group 1`	Associate the interface to the bridge.
`(config-if)#lldp-agent`	Enter into the default agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#set lldp chassis-id-tlv ip-address`	Configure the subtype for chassis-id TLV
`(if-lldp-agent)#set lldp port-id-tlv mac-address`	Configure the subtype for port-id TLV
`(if-lldp-agent)#lldp tlv basic-mgmt port-description select`	Enable the `port-description TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt system-name select`	Enable the `system-name TLV` to be transmitted on the port

`(if-lldp-agent)#lldp tlv basic-mgmt system-capabilities select`	Enable the `system-capabilities TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt system-description select`	Enable the `system-description TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt management-address select`	Enable the `management-address TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-vlanid select`	Enable the `VLAN-id TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vlan-name select`	Enable the `VLAN-NAME TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-ptcl-vlanid select`	Enable the `Port and Protocol VLAN id TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific ptcl-identity select`	Enable the `Protocol Identity TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vid-digest select`	Enable the `VID Usage Digest TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific mgmt-vid select`	Enable the `Management VID TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific link-agg select`	Enable the `Link Aggregation TLV` to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific mac-phy select`	Enable the MAC/PHY Configuration/Status TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific max-mtu-size select`	Enable the Maximum Frame Size TLV to be transmitted on the port
`(if-lldp-agent)#set lldp timer msg-fast-tx 5`	Defines the time interval during fast transmission periods
`(if-lldp-agent)#set lldp tx-fast-init 6`	Defines the number of LLDPDUs that are transmitted during a fast transmission period
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#exit`	Exit interface mode.

Validation

1. Verify the LLDP configurations in the local switch

```
#show running-config lldp
!
interface eth1
lldp-agent
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
  set lldp port-id-tlv mac-address
  lldp tlv basic-mgmt port-description select
  lldp tlv basic-mgmt system-name select
  lldp tlv basic-mgmt system-description select
  lldp tlv basic-mgmt system-capabilities select
  lldp tlv basic-mgmt management-address select
  lldp tlv ieee-8021-org-specific port-vlanid select
  lldp tlv ieee-8021-org-specific port-ptcl-vlanid select
  lldp tlv ieee-8021-org-specific vlan-name select
  lldp tlv ieee-8021-org-specific ptcl-identity select
  lldp tlv ieee-8021-org-specific vid-digest select
```

```
  lldp tlv ieee-8021-org-specific mgmt-vid select
  lldp tlv ieee-8021-org-specific link-agg select
  lldp tlv ieee-8023-org-specific mac-phy select
  lldp tlv ieee-8023-org-specific max-mtu-size select
  set lldp timer msg-fast-tx 5
  set lldp tx-fast-init 6
!
```

2. Verify the LLDP port statistics

```
#show lldp interface eth1 nearest-bridge

Agent Mode                    : Nearest bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 5
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Not Defined
 Traffic statistics           :
  Total frames transmitted    : 4
  Total entries aged          : 0
  Total frames received       : 3
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
```

Customer Bridge

All configuration commands in the table below should be followed for each switch.

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol ieee vlan-bridge`	Configure an IEEE VLAN-aware bridge.
`(config)#vlan database`	Enter VLAN configure mode.
`(config-vlan)#vlan 2 bridge 1 state enable`	Configure a VLAN and add it to the bridge.
`(config-vlan)#exit`	Exit the VLAN configuration mode.
`(config)#interface eth1`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#bridge-group 1`	Associate the interface to the bridge.
`(config-if)#lldp-agent customer-bridge`	Enter into the Customer Bridge agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#set lldp chassis-id-tlv ip-address`	Configure the subtype for chassis-id TLV
`(if-lldp-agent)#set lldp port-id-tlv mac-address`	Configure the subtype for port-id TLV
`(if-lldp-agent)#lldp tlv basic-mgmt port-description select`	Enable the port-description TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv basic-mgmt system-name select`	Enable the system-name TLV to be transmitted on the port.

`(if-lldp-agent)#lldp tlv basic-mgmt system-capabilities select`	Enable the system-capabilities TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv basic-mgmt system-description select`	Enable the system-description TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv basic-mgmt management-address select`	Enable the management-address TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-vlanid select`	Enable the VLAN-id TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vlan-name select`	Enable the VLAN-NAME TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-ptcl-vlanid select`	Enable the Port and Protocol VLAN id TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific ptcl-identity select`	Enable the Protocol Identity TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vid-digest select`	Enable the VID Usage Digest TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific mgmt-vid select`	Enable the Management VID TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific link-agg select`	Enable the Link Aggregation TLV to be transmitted on the port.
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific mac-phy select`	Enable the MAC/PHY Configuration/Status TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific max-mtu-size select`	Enable the Maximum Frame Size TLV to be transmitted on the port.
`(if-lldp-agent)#set lldp timer msg-fast-tx 5`	Defines the time interval during fast transmission periods.
`(if-lldp-agent)#set lldp tx-fast-init 6`	Defines the number of LLD PDUs that are transmitted during a fast transmission period.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#exit`	Exit interface mode.

Validation

1. Verify the LLDP configurations in the local switch:

```
#show #show running-config lldp
!
interface eth1
lldp-agent customer-bridge
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
  set lldp port-id-tlv mac-address
  lldp tlv basic-mgmt port-description select
  lldp tlv basic-mgmt system-name select
  lldp tlv basic-mgmt system-description select
  lldp tlv basic-mgmt system-capabilities select
  lldp tlv basic-mgmt management-address select
  lldp tlv ieee-8021-org-specific port-vlanid select
  lldp tlv ieee-8021-org-specific port-ptcl-vlanid select
  lldp tlv ieee-8021-org-specific vlan-name select
  lldp tlv ieee-8021-org-specific ptcl-identity select
  lldp tlv ieee-8021-org-specific vid-digest select
  lldp tlv ieee-8021-org-specific mgmt-vid select
```



```
  lldp tlv ieee-8021-org-specific link-agg select
  lldp tlv ieee-8023-org-specific mac-phy select
  lldp tlv ieee-8023-org-specific max-mtu-size select
  set lldp timer msg-fast-tx 5
  set lldp tx-fast-init 6
!
```

2. Verify the LLDP port statistics

```
#show lldp interface eth1 customer-bridge

Agent Mode                    : Customer-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 5
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Not Defined
 Traffic statistics           :
  Total frames transmitted    : 8
  Total entries aged          : 0
  Total frames received       : 7
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
```

Non-Tpmr-Bridge

The below configurations should be followed for each switch.

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol ieee vlan-bridge`	Configure an IEEE VLAN-aware bridge.
`(config)#vlan database`	Enter VLAN configure mode.
`(config-vlan)#vlan 2 bridge 1 state enable`	Configure a VLAN and add it to the bridge.
`(config-vlan)#exit`	Exit the VLAN configuration mode.
`(config)#interface eth1`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#bridge-group 1`	Associate the interface to the bridge.
`(config-if)#lldp-agent non-tpmr-bridge`	Enter into the Non tpmr Bridge agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#set lldp chassis-id-tlv ip-address`	Configure the subtype for chassis-id TLV
`(if-lldp-agent)#set lldp port-id-tlv mac-address`	Configure the subtype for port-id TLV
`(if-lldp-agent)#lldp tlv basic-mgmt port-description select`	Enable the port-description TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt system-name select`	Enable the system-name TLV to be transmitted on the port

`(if-lldp-agent)#lldp tlv basic-mgmt system-capabilities select`	Enable the system-capabilities TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt system-description select`	Enable the system-description TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv basic-mgmt management-address select`	Enable the management-address TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-vlanid select`	Enable the VLAN-id TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vlan-name select`	Enable the VLAN-NAME TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-ptcl-vlanid select`	Enable the Port and Protocol VLAN id TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific ptcl-identity select`	Enable the Protocol Identity TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific vid-digest select`	Enable the VID Usage Digest TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific mgmt-vid select`	Enable the Management VID TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8021-org-specific link-agg select`	Enable the Link Aggregation TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific mac-phy select`	Enable the MAC/PHY Configuration/Status TLV to be transmitted on the port
`(if-lldp-agent)#lldp tlv ieee-8023-org-specific max-mtu-size select`	Enable the Maximum Frame Size TLV to be transmitted on the port
`(if-lldp-agent)#set lldp timer msg-fast-tx 5`	Defines the time interval during fast transmission periods
`(if-lldp-agent)#set lldp tx-fast-init 6`	Defines the number of LLD PDUs that are transmitted during a fast transmission period
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#exit`	Exit interface mode.

Validation

1. Verify the LLDP configurations in the local switch:

```
#show running-config lldp
lldp-agent non-tpmr-bridge
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
  set lldp port-id-tlv mac-address
  lldp tlv basic-mgmt port-description select
  lldp tlv basic-mgmt system-name select
  lldp tlv basic-mgmt system-description select
  lldp tlv basic-mgmt system-capabilities select
  lldp tlv basic-mgmt management-address select
  lldp tlv ieee-8021-org-specific port-vlanid select
  lldp tlv ieee-8021-org-specific port-ptcl-vlanid select
  lldp tlv ieee-8021-org-specific vlan-name select
  lldp tlv ieee-8021-org-specific ptcl-identity select
  lldp tlv ieee-8021-org-specific vid-digest select
  lldp tlv ieee-8021-org-specific mgmt-vid select
  lldp tlv ieee-8021-org-specific link-agg select
  lldp tlv ieee-8023-org-specific mac-phy select
```

```
  lldp tlv ieee-8023-org-specific max-mtu-size select
  set lldp timer msg-fast-tx 5
  set lldp tx-fast-init 6

!
```

2. Verify the LLDP port statistics

```
#show lldp interface eth1 non-tmpr-bridge

Agent Mode                    : Non-TPMR-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 5
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : Y
  Device Type                 : Not Defined
 Traffic statistics           :
  Total frames transmitted    : 17
  Total entries aged          : 0
  Total frames received       : 6
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
```

Media Endpoint Devices TLV

Switch A

`(config)#interface eth1`	Enter interface mode.
`(config-if)#lldp-agent`	Enter the default agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#lldp-agent customer-bridge`	Enter the customer-bridge agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#lldp-agent non-tpmr-bridge`	Enter the non-tpmr-bridge agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#set lldp med-devtype net-connect`	Enter the med-devtype agent and set the device type to network connectivity.
`(config-if)#exit`	Exit agent mode.

Validation

```
#show run lldp
!
!
interface eth1
 lldp-agent
```

```
  set lldp enable txrx
 set lldp med-devtype net-connect
 lldp-agent non-tpmr-bridge
  set lldp enable txrx
 lldp-agent customer-bridge
  set lldp enable txrx
!
#

#show lldp interface eth1
Agent Mode                    : Customer-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : Y
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 97
  Total entries aged          : 1
  Total frames received       : 92
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
Agent Mode                    : Non-TPMR-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 89
  Total entries aged          : 0
  Total frames received       : 0
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
Agent Mode                    : Nearest bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 90
  Total entries aged          : 0
```

```
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
#
```

Switch B

`(config)#interface eth1`	Enter interface mode.
`(config-if)#lldp-agent`	Enter the default agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#lldp-agent customer-bridge`	Enter the customer-bridge agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#lldp-agent non-tpmr-bridge`	Enter the non-tpmr-bridge agent.
`(if-lldp-agent)#set lldp enable txrx`	Set the admin status of the LLDP agent.
`(if-lldp-agent)#exit`	Exit agent mode.
`(config-if)#set lldp med-devtype ep-class3`	Enter the med-devtype agent and set the device type to endpoint class 3.
`(config-if)#exit`	Exit agent mode.

Validation

```
#show running-config lldp
!
!
interface eth1
 lldp-agent
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
 set lldp med-devtype ep-class3
 lldp-agent non-tpmr-bridge
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
 lldp-agent customer-bridge
  set lldp enable txrx
  set lldp chassis-id-tlv ip-address
!
#

#show lldp interface eth1
Agent Mode                   : Customer-bridge
 Enable (tx/rx)              : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
```

```
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 11
  Total entries aged         : 0
  Total frames received      : 12
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
Agent Mode                   : Non-TPMR-bridge
 Enable (tx/rx)              : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 7
  Total entries aged         : 0
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
Agent Mode                   : Nearest bridge
 Enable (tx/rx)              : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 8
  Total entries aged         : 0
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
#
```

Global Mode TLV

LLDPv2 TLVs can be configured globally, making it applicable for all interfaces where LLDP is enabled.

Topology

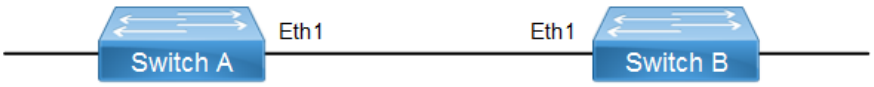


Figure 16-33: LLDP topology

SW1

`SW1#configure terminal`	Enter Configure mode
`SW1(config)#lldp tlv-select basic-mgmt port-description`	Enable LLDP port description TLV in global mode
`SW1(config)#lldp tlv-select basic-mgmt system-name`	Enable LLDP system name TLV in global mode
`SW1(config)#lldp tlv-select basic-mgmt system-capabilities`	Enable LLDP system capabilities TLV in global mode
`SW1(config)#lldp tlv-select basic-mgmt system-description`	Enable LLDP system description TLV in global mode
`SW1(config)#lldp tlv-select basic-mgmt management-address`	Enable LLDP management address TLV in global mode
`SW1(config)#interface eth1`	Enter interface mode
`SW1(config-if)#lldp-agent`	Enter LLDP interface mode
`SW1(if-lldp-agent)#set lldp enable txrx`	Enable LLDP TLV transmit and receive for the nearest bridge
`SW1(if-lldp-agent)#exit`	Exit LLDP mode
`SW1(config-if)#exit`	Exit interface mode
`SW1(config)#end`	Exit the configure mode

SW2

`SW2#configure terminal`	Enter Configure mode
`SW2(config)#lldp tlv-select basic-mgmt port-description`	Enable LLDP port description TLV in global mode
`SW2(config)#lldp tlv-select basic-mgmt system-name`	Enable LLDP system name TLV in global mode
`SW2(config)#lldp tlv-select basic-mgmt system-capabilities`	Enable LLDP system capabilities TLV in global mode
`SW2(config)#lldp tlv-select basic-mgmt system-description`	Enable LLDP system description TLV in global mode
`SW2(config)#lldp tlv-select basic-mgmt management-address`	Enable LLDP management address TLV in global mode
`SW2(config)#interface eth1`	Enter interface mode
`SW2(config-if)#lldp-agent`	Enter LLDP interface mode
`SW2(if-lldp-agent)#set lldp enable txrx`	Enable LLDP TLV transmit and receive for the nearest bridge
`SW2(if-lldp-agent)#exit`	Exit LLDP mode
`SW2(config-if)#exit`	Exit interface mode
`SW2(config)#end`	Exit the configure mode

Validation

```
SW1#show running-config lldp
!
lldp tlv-select basic-mgmt port-description
lldp tlv-select basic-mgmt system-name
lldp tlv-select basic-mgmt system-capabilities
lldp tlv-select basic-mgmt system-description
lldp tlv-select basic-mgmt management-address
!
interface eth1
 lldp-agent
  set lldp enable txrx


SW1#show lldp neighbors

Loc PortID      Rem Host Name      Rem Chassis Id     Rem Port Id       Agent Mode

--------------------------------------------------------------------------------
Eth1           OcNOS              cc37.ab56.6d80     cc37.abbb.ed81   Nearest bridge


SW1#show lldp neighbors detail

--------------------------------------------------------------------------------

Nearest bridge Neighbors
Interface Name              : eth1
 Mandatory TLVs
 Chassis id type          : MAC address [cc37.ab56.6d80]
 Port id type             : MAC address [cc37.abbb.ed81]
 Time to live             : 121
 Basic Management TLVs
 System Name              : SW2
 System Description       : Hardware Model:EC_AS4610-54, Software version: Oc
NOS,1.3.6.241a
 Port Description          : eth1
 Remote System Capabilities : Bridge
                              Router
 Capabilities Enabled     : Router
 Management Address        : MAC Address [cc37.abbb.ed81]
 Interface Number subtype  : ifindex
 Interface Number          10046
 OID Number               : 0
 802.1 Org specific TLVs
 Port vlan id              : 0
 Port & Protocol vlan id   : 0
 Remote Configured VLANs   : None
 Remote Protocols Advertised: None
```

```
 Remote VID Usage Digest   : 0
 Remote Management Vlan    : 0
 Link Aggregation Capability: not capable of being aggregated
 Link Aggregation Status   : not currently in aggregation
 Link Aggregation Port ID  :
 802.3 Org specific TLVs
 AutoNego Support          : Not-Supported
 AutoNego Status           : Disabled
 AutoNego Capability       : 0
 Operational MAU Type      : 0 [unknown]
  Max Frame Size            :
SW1#
```

LLDP-MED

LLDP extensions and behavior requirements are described specifically in the areas of network Configuration and policy, device location (including for Emergency Call Service / E911), Power over Ethernet management, and inventory management.

Based on the device type, different TLVs are advertised by the Station.

LLDP-MED Network Connectivity Device

LLDP-MED Network Connectivity Devices, as defined in this Standard, provide access to the IEEE 802 based LAN infrastructure for LLDP-MED Endpoint Devices. An LLDP-MED Network Connectivity Device is a LAN access device based on any of the following technologies:

- LAN Switch/Router
- IEEE 802.1 Bridge
- IEEE 802.3 Repeater (included for historical reasons)
- IEEE 802.11 Wireless Access Point
- Any device that supports the IEEE 802.1AB and MED extensions defined by this Standard and can relay IEEE 802 frames via any method.

Configuration Command

```
set lldp med-devtype net-connect
```

LLDP-MED Generic Endpoint (Class I)

The LLDP-MED Generic Endpoint (Class I) definition is applicable to all endpoint products that require the base LLDP discovery services, however do not support IP media or act as an end-user communication appliance. Such devices may include (but are not limited to) IP Communication Controllers, other communication related servers, or any device requiring basic services.

Configuration command:

```
set lldp med-devtype ep-class1
```

LLDP-MED Generic Endpoint (Class 2)

The LLDP-MED Media Endpoint (Class II) definition is applicable to all endpoint products that have IP media capabilities however may or may not be associated with a particular end user. Capabilities include all of the capabilities defined for the previous Generic Endpoint Class (Class I), and are extended to include aspects related to media streaming. Example product categories expected to adhere to this class include (but are not limited to) Voice / Media Gateways, Conference Bridges, Media Servers, and similar

Configuration command:

```
set lldp med-devtype ep-class2
```

LLDP-MED Generic Endpoint (Class 3)

The LLDP-MED Communication Endpoint (Class III) definition is applicable to all endpoint products that act as end user communication appliances supporting IP media. Capabilities include all of the capabilities defined for the previous Generic Endpoint (Class I) and Media Endpoint (Class II) classes, and are extended to include aspects related to end user devices. Example product categories expected to adhere to this class include (but are not limited to) end user communication appliances, such as IP Phones, PC-based softphones, or other communication appliances that directly support the end user.

Configuration command:

```
set lldp med-devtype ep-class3
```

Switch A

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol ieee vlan-bridge`	Configure an IEEE VLAN-aware bridge.
`(config)#vlan database`	Enter VLAN configure mode.
`(config-vlan)#vlan 2 bridge 1 state enable`	Configure a VLAN and add it to the bridge.
`(config-vlan)#exit`	Exit the VLAN configuration mode.
`(config)#interface eth1`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#bridge-group 1`	Associate the interface to the bridge.
`(config-if)#lldp-agent`	Enter into the default agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(if-config-if)#lldp-agent customer-bridge`	Enter into the customer-bridge agent.
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#lldp-agent non-tpmr-bridge`	Enter into the non-tpmr-bridge agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.

`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#set lldp med-devtype net-connect`	Configure the med device type
`(config-if)#exit`	Exit interface mode.

Switch B

`#configure terminal`	Enter configure mode.
`(config)#bridge 1 protocol ieee vlan-bridge`	Configure an IEEE VLAN-aware bridge.
`(config)#vlan database`	Enter VLAN configure mode.
`(config-vlan)#vlan 2 bridge 1 state enable`	Configure a VLAN and add it to the bridge.
`(config-vlan)#exit`	Exit the VLAN configuration mode.
`(config)#interface eth1`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#bridge-group 1`	Associate the interface to the bridge.
`(config-if)#lldp-agent`	Enter into the default agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#lldp-agent customer-bridge`	Enter into the customer-bridge agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#lldp-agent non-tpmr-bridge`	Enter into the non-tpmr-bridge agent
`(if-lldp-agent)#set lldp enable txrx`	Enable an LLDP agent on the port.
`(if-lldp-agent)#exit`	Exit the lldp agent mode
`(config-if)#set lldp med-devtype ep-class3`	Configure the med device type
`(config-if)#exit`	Exit interface mode.

Validation

1. Verify the LLDP configurations on Switch A:

```
#show running-config lldp
!
!
interface eth1
 lldp-agent
  set lldp enable txrx
 set lldp med-devtype net-connect
 lldp-agent non-tpmr-bridge
  set lldp enable txrx
 lldp-agent customer-bridge
  set lldp enable txrx
!
```

2. Verify the LLDP port statistics on Switch A:

```
#show lldp interface eth1
Agent Mode                    : Customer-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : Y
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 11
  Total entries aged          : 0
  Total frames received       : 10
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
Agent Mode                    : Non-TPMR-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 7
  Total entries aged          : 0
  Total frames received       : 0
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0
Agent Mode                    : Nearest bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 1
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Network Connectivity
 Traffic statistics           :
  Total frames transmitted    : 7
  Total entries aged          : 0
  Total frames received       : 0
  Total error frames received: 0
  Total frames discarded      : 0
  Total discarded TLVs        : 0
  Total unrecognised TLVs     : 0

#show lldp interface eth1 non-tpmr-bridge
Agent Mode                    : Non-TPMR-bridge
 Enable (tx/rx)               : Y/Y
 Message fast transmit time   : 5
 Message transmit interval    : 30
 Reinitialisation delay       : 2
 MED Enabled                  : N
  Device Type                 : Not Defined
 Traffic statistics           :
  Total frames transmitted    : 4
```

```
  Total entries aged         : 0
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
```

3. Verify the LLDP configurations for end device ep-class3 on Switch B:

```
#show running-config lldp
!
interface eth1
 set lldp med-devtype ep-class3
 lldp-agent
  set lldp enable txrx
  lldp tlv med network-policy select
lldp-agent non-TPMR-bridge
  set lldp enable txrx
  lldp tlv med network-policy select
lldp-agent customer-bridge
  set lldp enable txrx
  lldp tlv med network-policy select
!
```

4. Verify the LLDP port statistics on Switch B:

```
#show lldp interface eth1
Agent Mode                  : Customer-bridge
 Enable (tx/rx)             : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 124
  Total entries aged         : 0
  Total frames received      : 125
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
Agent Mode                  : Non-TPMR-bridge
 Enable (tx/rx)             : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 120
  Total entries aged         : 0
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
Agent Mode                  : Nearest bridge
```

```
 Enable (tx/rx)              : Y/Y
 Message fast transmit time  : 1
 Message transmit interval   : 30
 Reinitialisation delay      : 2
 MED Enabled                 : Y
  Device Type                : End Point Class-3
 Traffic statistics          :
  Total frames transmitted   : 120
  Total entries aged         : 0
  Total frames received      : 0
  Total error frames received: 0
  Total frames discarded     : 0
  Total discarded TLVs       : 0
  Total unrecognised TLVs    : 0
#
```

Layer 2 Command Reference

CHAPTER 1 Fundamental Layer 2 Commands

This chapter describes fundamental Layer 2 commands.

errdisable cause

Use this command to globally shut down a port when certain errors happen:

- BPDU guard puts an interface configured for Spanning Tree Protocol (STP) Port Fast into the ErrDisable state upon receipt of a STP BPDU to avoid a potential bridging loop.
- If one side of a link-access group (LAG) is configured as a static LAG and the other side as a dynamic LAG, the ports on the side receiving LACP BPDUs go into the ErrDisable state

Note: When link-flap ErrDisable is enabled globally, then all interfaces are enabled. Link-flap ErrDisable can be enabled globally, but disabled for a specific interface with the `no link-flap errdisable` command.

Use `no` form of this command to not shut down a port when certain errors happen.

Command Syntax

```
errdisable cause stp-bpdu-guard
no errdisable cause stp-bpdu-guard
errdisable cause {lag-mismatch|link-flap}
no errdisable cause {lag-mismatch|link-flap}
```

Parameters

`stp-bpdu-guard`	ErrDisable on stp-bpdu-guard
`lag-mismatch`	ErrDisable on lag-mismatch
`link-flap`	ErrDisable on link-flap

Default

STP-BPDU-Guard is enabled by default on the global level configuration.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#errdisable cause lag-mismatch
```

errdisable link-flap-setting

Use this command to configure the link-flap errdisable feature:

- An interface should change state as up-down to complete one cycle of a link flap.
- The LED does not glow when an interface is in the errdisable state.
- Errdisable is supported only on physical interfaces.
- A LAG interface does not go into the errdisable state when all of its member ports are in the errdisable state
- The error disable computation is based on a sliding window of time. The window size is configurable in seconds. This window is taken as the current time to the last <t> second, where <t> is the configured window size. If the accumulated link flap count reaches the maximum flap count for a particular sliding window, a link flap error disable fault is triggered.

Note: Any previous flapping accumulated is flushed when you execute this command.

Command Syntax

```
errdisable link-flap-setting max-flaps <1-100> time <1-1800>
no errdisable link-flap-setting
```

Parameters

<1-100>	Maximum flap count
<1-1800>	Sliding window size in seconds

Default

Five flaps in ten seconds:

Maximum flap count: 5

Sliding window size: 10 seconds

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#errdisable link-flap-setting max-flaps 5 time 20
```

errdisable timeout

Use this command to set the ErrDisable auto-recovery timeout interval.

Command Syntax

```
errdisable timeout interval <10-1000000>
no errdisable timeout interval
```

Parameters

<10-1000000>	Timeout interval in seconds

Default

By default, zero: timer is disabled

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#errdisable timeout interval 1000
```

show errdisable details

Use this command to display ErrDisable settings.

Command Syntax

```
show errdisable details
```

Parameters

None

Default

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show errdisable details
```

show interface errdisable status

Use this command to display ErrDisable conditions for an interface.

Command Syntax

```
show interface errdisable status
```

Parameters

None

Default

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show interface errdisable status
ge1 lag-mismatch-errdisable
ge2 stp-bpdu-guard-errdisable
```

show running-config switch

Use this command to display the running system switch configuration.

Command Syntax

```
show running-config switch bridge
show running-config switch dot1x
show running-config switch gmrp
show running-config switch gvrp
show running-config switch lacp
show running-config switch lmi
show running-config switch mstp
show running-config switch radius-server
show running-config switch rpsvt+
show running-config switch rstp
show running-config switch ptp
show running-config switch stp
show running-config switch synce
show running-config switch vlan
```

Parameters

`bridge`	Display Bridge group information.
`dot1x`	Display 802.1x port-based authentication information.
`gmrp`	Display GARP Multicast Registration Protocol (GMRP) information.
`gvrp`	Display GARP VLAN Registration Protocol (GVRP) information.
`lacp`	Display Link Aggregation Control Protocol (LACP) information.
`lmi`	Display Ethernet Local Management Interface Protocol (LMI) information.
`mstp`	Display Multiple Spanning Tree Protocol (MSTP) information.
`radius-server`	Display RADIUS server information.
`rpvst+`	Display Rapid Per-VLAN Spanning Tree (rpvst+) information.
`rstp`	Display Rapid Spanning Tree Protocol (RSTP) information.
`ptp`	Display Precision time Protocol (PTP)
`stp`	Display Spanning Tree Protocol (STP) information.
`synce`	Display synce information.
`vlan`	Display values associated with a single VLAN.

Default

None

Command Mode

Privileged exec mode, configure mode, router-map mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
(config)#show running-config switch stp
!
bridge 6 ageing-time 45
bridge 6 priority 4096
bridge 6 max-age 7
```

show tcp

Use this command to display the Transmission Control Protocol (TCP) connections details.

Command Syntax

```
show tcp
```

Parameters

None

Command Mode

Exec mode and privileged exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show tcp
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp        0      0 0.0.0.0:22            0.0.0.0:*              LISTEN
tcp        0      0 127.0.0.1:25          0.0.0.0:*              LISTEN
tcp        0      1 10.12.44.1:57740      127.0.0.1:705          CLOSE_WAIT
tcp       52      0 10.12.44.21:22        10.12.7.89:705         ESTABLISHED
tcp       85      0 10.12.44.21:57742     10.12.44.21:57738      ESTABLISHED
```

Table 1: Show tcp output

Entry	Description
Proto	Protocol – TCP
Recv-Q	Number of TCP packets in the Receive Queue.
Send-Q	Number of TCP packets in the Send-Q.
Local Address and port number	Local IP address and the port number.

Table 1: Show tcp output (Continued)

Entry	Description
Foreign Address and port number	Foreign (received) IP address and the port number.
State	Current state of TCP connections: ESTABLISHED SYN_SENT SYN_RECV FIN_WAIT1 FIN_WAIT2 TIME_WAIT CLOSE CLOSE_WAIT LAST_ACK LISTEN CLOSING UNKNOWN

watch static-mac-movement

Use this command to watch if any MAC movement is detected over static MAC entries for a time period. Notification will be displaying if static MAC movement happens before the timer expires.

The counters can be validated with show interface counters queue-stats for the L2 movement queue (`Tx pkts` and `Dropped pkts` columns).

Without enabling `watch static-mac-movement`, the statistics are reflected in the `Rx EGR Port Unavail` of show interface counters queue-drop-stats.

For VXLAN, `watch static-mac-movement` applies to all the MAC entries learned from the remote peer (remote dynamic or static remote), as these learned MACs are installed as static MAC entries in the hardware.

Command Syntax

```
watch static-mac-movement (<1-300>|)
```

Parameters

`<1-300>`	Timer value in seconds.

Default

By default, the timer is 10 seconds

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#watch static-mac-movement
```

CHAPTER 2 Bridge Commands

This chapter provides a description, syntax, and examples of the bridge commands. It includes the following commands:

bridge acquire

Use this command to enable a bridge to learn station location information for an instance. This helps in making forwarding decisions.

Use the `no` parameter with this command to disable learning.

Command Syntax

```
bridge <1-32> acquire
no bridge <1-32> acquire
```

Parameter

`<1-32>`	Specify the bridge group ID.

Default

By default, learning is enabled for all instances.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 3 acquire
(config)#no bridge 3 acquire
```

bridge address

Use this command to add a static forwarding table entry for the bridge.

Use the no parameter with this command to remove the entry for the bridge

Command Syntax

```
bridge <1-32> address XXXX.XXXX.XXXX (forward|discard) IFNAME
bridge <1-32> address XXXX.XXXX.XXXX (forward|discard) IFNAME vlan <2-4094>
bridge <1-32> address XXXX.XXXX.XXXX  (forward|discard) IFNAME vlan <2-4094> svlan
  <2-4094>
no bridge <1-32> address XXXX.XXXX.XXXX
no bridge <1-32> address XXXX.XXXX.XXXX vlan <2-4094>
no bridge <1-32> address XXXX.XXXX.XXXX vlan <2-4094> svlan <2-4094>
```

Parameters

`<1-32>`	Bridge identifier
`XXXX.XXXX.XXXX`	Media Access Control (MAC) address in HHHH.HHHH.HHHH format.
`forward`	Forward matching frames.
`discard`	Discard matching frames.
`IFNAME`	Interface on which the frame comes out.
`vlan`	Identity of the VLAN in the range of <2-4094>.
`svlan`	Identity of the SVLAN in the range of <2-4094>.

Defaul

By default, bridge address is disabled

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 1 address 0000.000a.0021 forward eth0
(config)#no bridge 1 address 0000.000a.0021
```

bridge ageing

Use this command to specify the aging time for a learned MAC address. A learned MAC address persists until this specified time.

Note: The bridge aging time affects the ARP entries which are dependent upon the MAC addresses in hardware. If a MAC address ages out, it causes the corresponding ARP entry to refresh.

Note: On Qumran, the MAC aging time can vary by up to 16%. For example, if the MAC aging time is set to 60 seconds, the aging time can happen anywhere between 50-60 seconds.

Use the `no` form of this command to set the MAC address aging time to its default (300).

Command Syntax

```
bridge <1-32> ageing-time (0|<10-572>)
bridge <1-32> ageing disable
no bridge <1-32> ageing-time
```

Parameters

`0`	Disable Ageing Time
`<1-32>`	Bridge group ID.
`<10-572>`	Aging time in seconds.
`disable`	Turn off MAC address aging completely.

Default

By default, the aging time is 300 seconds.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 3 ageing-time 100
(config)#no bridge 3 ageing-time
```

bridge forward-time

Use this command to set the time (in seconds) after which (if this bridge is the root bridge) each port changes states to learning and forwarding. This value is used by all instances.

Use the `no` parameter with this command to restore the default value of 15 seconds.

Command Syntax

```
bridge <1-32> forward-time <4-30>
no bridge <1-32> forward-time
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<4-30>`	Specify the forwarding time delay in seconds.

Note: Care should be exercised if the value is to be made below 7 seconds.

Default

By default, value is 15 seconds

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 3 forward-time 6
(config)#no bridge 3 forward-time
```

bridge hello-time

Use this command to set the hello-time, the time in seconds after which (if this bridge is the root bridge) all the bridges in a bridged LAN exchange Bridge Protocol Data Units (BPDUs). A very low value of this parameter leads to excessive traffic on the network, while a higher value delays the detection of topology change.This value is used by all instances.

Configure the bridge instance name before using this command. The allowable range of values is 1-10 seconds. However, make sure that the value of hello time is always greater than the value of hold time (2 seconds by default).

Use the `no` parameter to restore the default value of the hello time.

Note: A Bridge shall enforce the following relationships for Hello-time, Max-age and Forward-delay.

- 2 × (Bridge_Forward_Delay – 1.0 seconds) >= Bridge_Max_Age
- Bridge_Max_Age >= 2 × (Bridge_Hello_Time + 1.0 seconds)

Note: Hello-time is allowed only on RSTP, IEEE and Provider-RSTP types of bridges. For MSTP and Provider-MSTP hello timer is restricted.

Command Syntax

```
bridge <1-32> hello-time <1-10>
no bridge <1-32> hello-time
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<1-10>`	Specify the hello BPDU interval in seconds.

Default

By default, value is 2 seconds

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 3 hello-time 3

(config)#no bridge 3 hello-time
```

bridge mac-priority-override

Use this command to set a MAC priority override.

Use the `no` parameter with this command to unset a MAC priority override.

Command Syntax

```
bridge <1-32> mac-priority-override mac-address MAC interface IFNAME vlan VLANID
  (static|static-priority-override|static-mgmt|static-mgmt-priority-overide)
  priority <0-7>
no bridge <1-32> mac-priority-override mac-address MAC interface IFNAME vlan VLANID
```

Parameters

`<1-32>`	Specify the bridge group ID.
`mac-address`	Enter a MAC address in HHHH.HHHH.HHHH format.
`interface`	Interface information
`vlan`	Add the values associated with a single VLAN
`static`	The MAC is a static entry
`static-mgmt`	The MAC is a Static Management
`static-mgmt-priority-overide`	The MAC is a Static Management with priority override
`static-priority-override`	The MAC is a static with priority override
`priority`	priority <0-7> priority value

Default

No default address is specified

Command Mode

Configuration Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 mac-priority-override mac-address 1111.1111.1111 interface
eth1 vlan 2 static priority 2

(config)#no bridge 1 mac-priority-override mac-address 1111.1111.1111
interface eth1 vlan 2
```

bridge max-age

Use this command to set the maximum age for a bridge. This value is used by all instances.

Maximum age is the maximum time in seconds for which (if a bridge is the root bridge) a message is considered valid. This prevents the frames from looping indefinitely. The value of maximum age should be greater than twice the value of hello time plus 1, but less than twice the value of forward delay minus 1. The allowable range for max-age is 6-40 seconds. Configure this value sufficiently high, so that a frame generated by root can be propagated to the leaf nodes without exceeding the maximum age.

Use the `no` parameter with this command to restore the default value of the maximum age.

Note: A Bridge shall enforce the following relationships for Hello-time, Max-age and Forward-delay.

- 2 × (Bridge_Forward_Delay – 1.0 seconds) >= Bridge_Max_Age
- Bridge_Max_Age >= 2 × (Bridge_Hello_Time + 1.0 seconds)

Command Syntax

```
bridge <1-32> max-age <6-40>
no bridge <1-32> max-age
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<6-40>`	Specify the maximum time, in seconds, to listen for the root bridge <6-40>.

Default

By default, bridge maximum age is 20 seconds

Command Mode

Configure Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 max-age 12

(config)#no bridge 2 max-age
```

bridge max-hops

Use this command to specify the maximum allowed hops for a BPDU in an MST region. This parameter is used by all the instances of the MST. Specifying the maximum hops for a BPDU prevents the messages from looping indefinitely in the network. When a bridge receives an MST BPDU that has exceeded the allowed maximum hops, it discards the BPDU.

Use the `no` parameter with this command to restore the default value.

Command Syntax

```
bridge <1-32> max-hops <1-40>
no bridge <1-32> max-hops
```

Parameters

`<1-32>`	Specify the bridge-group ID.
`<1-40>`	Specify the maximum hops for which the BPDU will be valid <1-40>.

Default

By default, maximum hops in an MST region are 20

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 3 max-hops 25

#configure terminal
(config)#no bridge 3 max-hops
```

bridge priority

Use this command to set the bridge priority for the common instance. Using a lower priority indicates a greater likelihood of the bridge becoming root. The priority values can be set only in increments of 4096.

Use the `no` form of the command to reset it to the default value.

Command Syntax

```
bridge (<1-32> | ) priority <0-61440>
no bridge (<1-32> | )priority
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<0-61440>`	Specify the bridge priority in the range of <0-61440>.

Default

By default, priority is 32768 (or hex 0x8000).

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 priority 4096

(config)#no bridge 2 priority
```

bridge shutdown

Use this command to disable a bridge.

Use the `no` parameter to reset the bridge.

Command Syntax

```
bridge shutdown <1-32>
bridge shutdown <1-32> ((bridge-blocked|bridge-forward)|)
no bridge shutdown <1-32>
```

Parameters

`<1-32>`	Specify the bridge group ID.
`bridge-forward`	Put all ports of the bridge into forwarding state
`bridge-blocked`	Put all ports of the bridge into blocked state

Default

No default value is specified

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge shutdown 4
(config)#no bridge shutdown 4
```

bridge transmit-holdcount

Use this command to set the maximum number of transmissions of BPDUs by the transmit state machine.

Use the `no` parameter with this command to restore the default transmit hold-count value.

Command Syntax

```
bridge <1-32> transmit-holdcount <1-10>
no bridge <1-32> transmit-holdcount
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<1-10>`	Transmit hold-count value.

Default

By default, transmit hold-count is 6

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 transmit-holdcount 5

(config)#no bridge 1 transmit-holdcount
```

bridge-group

Use this command to bind an interface with a bridge specified by the parameter.

Use the `no` parameter with this command to disable this command.

Command Syntax

```
bridge-group (<1-32>)
no bridge-group (<1-32>)
```

Parameters

`<1-32>`	Specify the bridge group ID.

Default

By default, bridge-group is disabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#bridge-group 2

(config)#interface eth1
(config-if)#no bridge-group 2
```

bridge-group path-cost

Use this command to set the cost of a path associated with a bridge group. The lower the path cost, the greater the likelihood of the bridge becoming root.

Use the `no` parameter with this command to restore the default priority value.

Command Syntax

```
bridge-group <1-32> path-cost <1-200000000>
no bridge-group <1-32> path-cost
```

Parameters

`<1-32>`	Specify the bridge group ID.
`path-cost`	Specify the path-cost of a port.
`<1-200000000>`	Specify the cost to be assigned to the group.

Default

By default, bridge-group is disabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#bridge-group 3 path-cost 123

(config-if)#no bridge-group 3 path-cost
```

bridge-group priority

Use this command to set the port priority for a bridge. A lower priority indicates a greater likelihood of the bridge becoming root.

Command Syntax

```
bridge-group <1-32> priority <0-240>
no bridge-group <1-32> priority
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<0-240>`	Specify the port priority range (a lower priority indicates greater likelihood of the interface becoming a root). The priority values can only be set in increments of 16.

Default

By default, priority is 1

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#bridge-group 4 priority 96

(config)#interface eth1
(config-if)#no bridge-group 4 priority
```

clear allowed-ethertype

Use this command to clear statistics for each ethertype per interfaces.

```
clear allowed-ethertype statistics (IFNAME|)
```

Parameters

IFNAME	Interface name.

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#clear allowed-ethertype statistics xe54/1

#show allowed-ethertype statistics xe54/1
Interface xe54/1
arp: 0 Packets, 0 Bytes
ipv4: 0 Packets, 0 Bytes
ipv6: 0 Packets, 0 Bytes
dropped: 0 Packets, 0 Bytes
```

clear mac address-table

Use this command to clear the filtering database for the bridge. This command can be issued to do the following:

- clear the filtering database
- clear all filtering database entries configured through CLI (static)
- clear all multicast filtering database entries
- clear all multicast filtering database entries for a given VLAN or interface
- clear all dynamic or multicast database entries based on a mac address

Command Syntax

```
clear mac address-table (dynamic|multicast) bridge <1-32>
clear mac address-table (dynamic|multicast) (address MACADDR | interface IFNAME |
  vlan VID ) bridge <1-32>
clear mac address-table (dynamic|multicast) (address MACADDR | interface IFNAME |
  vlan VID ) (instance INST) bridge <1-32>
```

Parameters

`dynamic`	Clears all dynamic entries.
`multicast`	Clears all multicast filtering database entries.
`address`	Clear the specified MAC Address.
`MACADDR`	When filtering database, entries are cleared based on the MAC address.
`bridge`	Clears the bridge group ID. Value range is 1-32.
`bridge`	Clears the bridge group ID. Value range is 1-32.
`cvlan`	Clears all MAC address for the specified CVLAN. Value range is 1-4094.
`svlan`	Clears all mac address for the specified SVLAN. Value range is 1-4094.
`interface`	Clears all MAC address for the specified interface.
`bridge`	Clears the bridge group ID. Value range is 1-32.
`instance`	Clears MSTP instance ID. Value range is <1-63>.
`vlan`	Clears all MAC address for the specified VLAN. Value range is 1-4094.
`bridge`	Clears the bridge group ID. Value range is 1-32.

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

This example shows how to clear multicast filtering database entries:

```
#clear mac address-table multicast bridge 1
```

This example shows how to clear multicast filtering database entries for a given VLAN.

```
#clear mac address-table multicast vlan 2 bridge 1
```

This example shows how to clear all filtering database entries learned through bridge operation for a given MAC address.

```
#clear mac address-table dynamic address 0202.0202.0202 bridge 1
```

mac ageing display

Use this command to enable the display of remaining age-time value for dynamically learnt mac address.

Note: When the mac ageing display is enabled the following points are applicable .

a. The mac ageing display should be enabled in non-scaled case (i.e less than 25% of table size) .

b. High cpu usage will occurs if mac-ageing-display is enabled in scaled case.

c. When enabled ,the appropriate ageing time for each entry will only be displayed after the first iteration of the ageing thread is complete which starts after 10 seconds of the cli commit .

d. For mac entries with no active traffic, the age of the entries will be displayed based on the timestamp when the entries were first learnt. if the entries learnt time is greater than the bridge-mac-age-time (default 300secs), the age of the mac entries will be displayed as zero.

Use the `no` form of this command to disable the display of MAC address aging timeout. When disabled the mac-address age will be the bridge-mac-age-time default 300secs.

Command Syntax

```
mac-ageing-display
no mac-ageing-display
```

Parameters

None

Default

By default, mac ageing display is disabled.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS DC Version 5.0.

Example

```
#configure terminal
(config)#mac-ageing-display
(config)#no mac-ageing-display
```

show allowed-ethertype

Use this command to show allowed and denied traffic statistics.

Note: Dropped slow protocol packets provides the count of slow protocol packets among the total dropped count. Total drop count is fetched from hardware and slow protocol packet count is fetched from software. Hence there can be one or two packet difference.

Command Syntax

```
show allowed-ethertype statistics (IFNAME|)
```

Parameters

IFNAME	Interface name.

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#show allowed-ethertype statistics
Interface po1
arp : 0 Packets, 0 Bytes
ipv4 : 511016709 Packets, 184897169366 Bytes
ipv6 : 0 Packets, 0 Bytes
dropped : 220 Packets, 28160 Bytes
dropped slow protocol pkts : lacp 220, efm 0, others 0
Interface xe47
arp : 0 Packets, 0 Bytes
ipv4 : 169763534 Packets, 61427990740 Bytes
ipv6 : 0 Packets, 0 Bytes
dropped : 0 Packets, 0 Bytes
Interface xe48
arp : 0 Packets, 0 Bytes
ipv4 : 0 Packets, 0 Bytes
ipv6 : 0 Packets, 0 Bytes
dropped : 0 Packets, 0 Bytes
```

show bridge

Use this command to display the filtering database for the bridge. The filtering database is used by a switch to store the MAC addresses that have been learned and which ports that MAC address was learned on.

Command Syntax

```
show bridge (ieee|rpvst+|mstp|)
```

Parameters

`ieee`	STP bridges.
`rpvst+`	RPVST+ bridges.
`mstp`	MSTP bridges.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show bridge
Ageout time is global and if something is configured for vxlan then it will be affected
here also
 Bridge    CVLAN  SVLAN  BVLAN  Port         MAC Address        FWD   Time-out
 --------+------+------+------+-----------+-----------------+-----+---------+
 1         1                   eth1         5254.0029.929c     1     0
 1         2                   eth1         5254.004c.dcc6     1     297
 1         1                   eth1         5254.004c.dcc6     1     291
```

Table 2-1 explains the show command output fields.

Table 2-1: show bridge output fields

Field	Description
Bridge	Bridge identifier.
VLAN, SVLAN, BVLAN	CVLAN, SVLAN, and BVLAN identifiers.
Port	Interface name.
MAC Address	Learned MAC address.
FWD	Whether frames for the MAC addresses are forwarded.
Time-out	How long the learned MAC address persists.

show interface switchport

Use this command to display the characteristics of the interface with the current VLAN.

Command Syntax

```
show interface switchport bridge <1-32>
```

Parameter

`bridge`	Bridge name.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following is an output of this command displaying the characteristics of this interface on bridge 2.

```
#show interface switchport bridge 2
 Interface name          : eth5
 Switchport mode         : access
 Ingress filter          : disable
 Acceptable frame types  : all
 Vid swap                : disable
 Default vlan            : 2
 Configured vlans        :    2
 Interface name          : eth4
 Switchport mode         : access
 Ingress filter          : disable
 Acceptable frame types  : all
 Vid swap                : disable
 Default vlan            : 1
 Configured vlans        :    1
```

Table 2-2 explains the show command output fields.

Table 2-2: show interface switchport output fields

Field	Description
Interface name	Display the name of interface.
Switchport mode	Port that used to connect between switches and access port.
Ingress filter	Ingress filtering examines all inbound packets and then permits or denies entry to the network.
Acceptable frame types	Type of acceptable frame in the interface.
VID swap	Displays the status of the VID swap.

Table 2-2: show interface switchport output fields (Continued)

Field	Description
Default vlan	Default value for the VLAN.
Configured vlans	Displays the information on configured VLANs.

show mac address-table count bridge

Use this command to display a count of MAC entries from the filtering database.

Command Syntax

```
show mac address-table (local|remote) bridge <1-32> ({address MAC | interface
  IFNAME | vlan <1-4094> }|)
```

Parameter

`local`	MAC entries learned locally
`remote`	MAC entries learned from MLAG MAC sync
`<1-32>`	Bridge group
`MAC`	MAC address in HHHH.HHHH.HHHH format
`IFNAME`	Name of the interface
`<1-4094>`	VLAN identifier

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show mac address-table count bridge 1
MAC Entries for all vlans:
Total MAC Addresses in Use: 3
```

Table 2-3 explains the show command output fields.

Table 2-3: show mac address-table count output fields

Field	Description
Multicast MAC Address Count	Number of multicast addresses.
Total MAC Addresses	Total number of addresses.

show mac address-table bridge

Use this command to display MAC entries from the filtering database.

Command Syntax

```
show mac address-table (local|remote) bridge <1-32>({address MAC|interface
  FNAME|vlan <1-4094>}|)
show mac address-table count bridge <1-32>({(dynamic|multicast|static)|address
  MAC|interface IFNAME|vlan <1-4094>}|)
```

Parameter

`local`	MAC entries learned locally
`remote`	MAC entries learned from MLAG MAC sync
`<1-32>`	Bridge group
`dynamic`	Dynamic entries
`multicast`	Multicast entries
`static`	Static entries
`MAC`	MAC address in HHHH.HHHH.HHHH format
`IFNAME`	Name of the interface
`<1-4094>`	VLAN identifier

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show mac address-table bridge 1 static interface ge14
 VLAN     MAC Address     Type      Ports
  ------+--------------+---------+---------+--------------
  1      3333.3333.3333   static    ge14

#show mac address-table bridge 1
 VLAN     MAC Address     Type      Ports
  ------+--------------+---------+---------+--------------
  1      3417.ebf6.0ace   dynamic   po1
  1      6400.6a8e.48ab   dynamic   po1
  1      a82b.b5b5.c37b   dynamic   po1
  200    0000.5e00.0101   dynamic   po1
  200    3417.ebf6.0ac5   dynamic   po1
  200    3417.ebf6.0ace   dynamic   po1
  200    6400.6a8e.48ab   dynamic   po1
  200    a82b.b5b5.c375   dynamic   po1
  200    a82b.b5b5.c37b   dynamic   po1
  800    0000.5e00.0102   dynamic   po1
  800    3417.ebf6.0ac5   dynamic   po1
```

```
800     3417.ebf6.0ace   dynamic   po1
800     6400.6a8e.48ab   dynamic   po1
800     a82b.b5b5.c375   dynamic   po1
800     a82b.b5b5.c37b   dynamic   po1
```

Table 2-4 explains the show command output fields.

Table 2-4: show mac address-table output fields

Field	Description
VLAN	VLAN identifier.
MAC Address	Media Access Control address.
Type	Dynamic, multicast, or static.
Ports	Interface name.

switchport

Use this command to set the mode of an interface to switched.

All interfaces are configured routed by default. To change the behavior of an interface from switched to routed, you must explicitly give the `no switchport` command.

Note: When you change the mode of an interface from switched to routed and vice-versa, all configurations for that interface are erased.

Use the `no` form of this command to set the mode to routed.

Command Syntax

```
switchport
```

```
no switchport
```

Parameters

None

Default

All interfaces are configured routed by default. To change the behavior of an interface from switched to routed, you must explicitly give the no switchport command.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#switchport

(config)#interface eth0
(config-if)#no switchport
```

switchport allowed ethertype

Use this command to allow a set of ethertype on the access port and deny remaining traffic.

Use the no command to remove ethertype configuration.

Command Syntax

```
switchport allowed ethertype {arp|ipv4|ipv6|mpls|WORD|log}
no switchport allowed ethertype ({arp|ipv4|ipv6|mpls|WORD|log}|)
```

Parameters

`arp`	Ethertype 0x0806.
`ipv4`	Ethertype 0x0800.
`ipv6`	Ethertype 0x086dd.
`mpls`	Ethertype 0x8847.
`WORD`	Any Ethertype value (0x600 - 0xFFFF).
`log`	Log unwanted ethertype packets.

Default

No default value is specified

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#switchport allowed ethertype arp ipv4 ipv6 log

(config-if)#no switchport allowed ethertype ipv4
```

CHAPTER 3 Spanning Tree Protocol Commands

This chapter provides a description, syntax, and examples of the Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), and Provider RSTP commands.

bridge cisco-interoperability

Use this command to enable/disable Cisco interoperability for MSTP (Multiple Spanning Tree Protocol).

If Cisco interoperability is required, all OcNOS devices in the switched LAN must be Cisco-interoperability enabled. When OcNOS inter operates with Cisco, the only criteria used to classify a region are the region name and revision level. VLAN-to-instance mapping is not used to classify regions when interoperating with Cisco.

Command Syntax

```
bridge <1-32> cisco-interoperability (enable | disable)
```

Parameters

`<1-32>`	Specify the bridge group ID
`enable`	Enable Cisco interoperability for MSTP bridge
`disable`	Disable Cisco interoperability for MSTP bridge

Default

By default, cisco interoperability is disabled.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

To enable Cisco interoperability on a switch for a bridge:

```
#configure terminal
(config)#bridge 2 cisco-interoperability enable
```

To disable Cisco interoperability on a switch for a particular bridge:

```
#configure terminal
(config)#bridge 2 cisco-interoperability disable
```

bridge instance

Use this command to add an MST instance to a bridge.

Use the `no` form of this command to delete an MST instance identifier from a bridge.

Command Syntax

```
bridge (<1-32>) instance (<1-63>)
no bridge (<1-32>) instance (<1-63>)
```

Parameters

`<1-32>`	Bridge identifier.
`<1-63>`	MST instance identifier.

Default

The bridge instance default is 1.

Command Mode

MST configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 4 protocol mstp
(config)#spanning-tree mst configuration
(config-mst)#bridge 4 instance 3
...
(config-mst)#no bridge 4 instance 3
```

bridge instance priority

Use this command to set the bridge instance priority.

Use the `no` form of this command to reset the priority to its default.

Command Syntax

```
bridge (<1-32>) instance <1-63> priority <0-61440>
no bridge (<1-32>) instance <1-63> priority
```

Parameters

`<1-32>`	Specify the bridge identifier.
`<1-63>`	Specify the instance identifier.
`priority`	Specify the bridge priority for the instance. The lower the priority of the bridge, the better the chances is of the bridge becoming a root bridge or a designated bridge for the LAN. The priority values can be set only in increments of 4096. The default value is 32768.
`<0-61440>`	Specify the bridge priority.

Default

By default, bridge instance priority is 32768

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#bridge 4 instance 3 priority 1
```

bridge instance vlan

Use this command to simultaneously add multiple VLANs for the corresponding instance of a bridge.The VLANs must be created before being associated with an MST instance (MSTI). If the VLAN range is not specified, the MSTI will not be created.

Use the `no` form of this command to simultaneously remove multiple VLANs for the corresponding instance of a bridge.

Command Syntax

```
bridge (<1-32>) instance (<1-63>) vlan VLANID
no bridge (<1-32>) instance (<1-63>) vlan VLANID
```

Parameters

`<1-32>`	Bridge identifier.
`<1-63>`	MST instance identifier.
`VLANID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list. For a VLAN range, specify two VLAN identifiers: the lowest and then the highest separated by a hyphen. For a VLAN list, specify the VLAN identifiers separated by commas. Do not enter spaces between the hyphens or commas.

Default

The bridge instance VLAN ID Interfaces default-switch is VLAN100 100 ae0.0 ae1.0 ae2.0.

Command Mode

MST configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

To associate multiple VLANs, in this case VLANs 10 and 20 to instance 1 of bridge 1:

```
#configure terminal
(config)#bridge 1 protocol mstp
(config)#spanning-tree mst configuration
(config-mst)#bridge 1 instance 1 vlan 10,20
```

To associate multiple VLANs, in this case, VLANs 10, 11, 12, 13, 14, and 15 to instance 1 of bridge 1:

```
#configure terminal
(config)#bridge 1 protocol mstp
(config)#spanning-tree mst configuration
(config-mst)#bridge 1 instance 1 vlan 10-15
```

To delete multiple VLANs, in this case, VLANs 10 and 11 from instance 1 of bridge 1:

```
#configure terminal
(config)#bridge 1 protocol mstp
(config)#spanning-tree mst configuration
(config-mst)#no bridge 1 instance 1 vlan 10,11
```

bridge multiple-spanning-tree

Use this command to enable MSTP globally on a bridge.

Use the `no` form of this command to disable MSTP globally on a bridge.

Command Syntax

```
bridge <1-32> multiple-spanning-tree enable
no bridge <1-32> multiple-spanning-tree enable (bridge-blocked|bridge-forward|)
```

Parameters

`<1-32>`	Bridge-group ID.
`bridge-blocked`	Put ports of the bridge in the blocked state (default).
`bridge-forward`	Put ports of the bridge in the forwarding state.

Default

By default, this feature is enabled.

For the `no` form of this command, `bridge-blocked` is the default.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 multiple-spanning-tree enable

#configure terminal
(config)#no bridge 2 multiple-spanning-tree enable bridge-forward
```

bridge protocol ieee

Use this command to add a IEEE 802.1d Spanning Tree Protocol bridge.

After creating a bridge instance, add interfaces to the bridge using the `bridge-group` command. Bring the bridge instance into operation with the `no shutdown` command in interface mode.

Use the `no` parameter with this command to remove the bridge.

Command Syntax

```
bridge <1-32> protocol ieee (vlan-bridge|)
no bridge <1-32>
```

Parameters

`<1-32>`	Specify the bridge group ID.
`vlan-bridge`	Specify this as a VLAN-aware bridge.

Default

The bridge protocol default value is 2 seconds.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 3 protocol ieee

(config)#bridge 4 protocol ieee vlan-bridge
```

bridge protocol mstp

Use this command to create a multiple spanning-tree protocol (MSTP) bridge of a specified parameter. This command creates an instance of the spanning tree and associates the VLANs specified with that instance.

The MSTP bridges can have different spanning-tree topologies for different VLANs inside a region of “similar” MSTP bridges. The multiple spanning tree protocol, like the rapid spanning tree protocol, provides rapid reconfiguration capability, while providing load balancing ability. A bridge created with this command forms its own separate region unless it is added explicitly to a region using the `region name` command.

Use the `no` parameter with this command to remove the bridge.

Command Syntax

```
bridge <1-32> protocol mstp
no bridge <1-32>
```

Parameters

`<1-32>`	Specify the bridge group ID.

Default

The bridge protocol mstp default value is 50 seconds

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 protocol mstp
```

bridge protocol rstp

Use this command to add an IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) bridge.

After creating a bridge instance, add interfaces to the bridge using the `bridge-group` command. Bring the bridge instance into operation with the `no shutdown` command in Interface mode.

Use the `no` parameter with this command to remove the bridge.

Command Syntax

```
bridge <1-32> protocol rstp
bridge <1-32> protocol rstp (vlan-bridge|)
no bridge <1-32>
```

Parameters

`<1-32>`	Specify the bridge group ID.
`vlan-bridge`	(Optional) Adds a VLAN-aware bridge.

Default

By default, bridge protocol rstp is enabled

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 protocol rstp

#configure terminal
(config)#bridge 3 protocol rstp vlan-bridge
```

bridge provider-rstp

Use this command to enable Provider Rapid Spanning Tree Protocol (Provider RSTP) globally on a bridge.

Use the `no` form of this command to disable Provider RSTP globally on a bridge.

Command Syntax

```
bridge <1-32> provider-rstp enable
no bridge <1-32> provider-rstp enable (bridge-blocked|bridge-forward|)
```

Parameters

`<1-32>`	Bridge group ID.
`bridge-blocked`	Put ports of the bridge in the blocked state (default).
`bridge-forward`	Put ports of the bridge in the forwarding state.

Default

By default, this feature is enabled.

For the `no` form of this command, `bridge-blocked` is the default.

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 provider-rstp enable

#configure terminal
(config)#no bridge 1 provider-rstp enable bridge-block
```

bridge rapid-spanning-tree

Use this command to enable Rapid Spanning Tree Protocol (RSTP) globally on a bridge.

Use the `no` form of the command to disable RSTP globally on a bridge.

Command Syntax

```
bridge <1-32> rapid-spanning-tree enable
no bridge <1-32> rapid-spanning-tree enable (bridge-blocked|bridge-forward|)
```

Parameters

`<1-32>`	Bridge group ID.
`bridge-blocked`	Put ports of the bridge in the blocked state (default).
`bridge-forward`	Put ports of the bridge in the forwarding state.

Default

By default, this feature is enabled.

For the `no` form of this command, `bridge-blocked` is the default.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 rapid-spanning-tree enable

#configure terminal
(config)#no bridge 2 rapid-spanning-tree enable bridge-forward
```

bridge region

Use this command to create an MST region and specify its name. MST bridges of a region form different spanning trees for different VLANs.

Use the `no` form of the command to disable the Rapid Spanning Tree protocol on a region.

Command Syntax

```
bridge <1-32> region REGION_NAME
no bridge <1-32> region
```

Parameters

`<1-32>`	Specify the bridge group ID.
`REGION_NAME`	Specify the name of the region.

Default

By default, each MST bridge starts with the region name as its bridge address. This means each MST bridge is a region by itself, unless specifically added to one.

Command Mode

MST configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree mst configuration
(config-mst)#bridge 3 region myRegion

(config)#spanning-tree mst configuration
(config-mst)#no bridge 3 region
```

bridge revision

Use this command to specify the number for configuration information.

Command Syntax

```
bridge <1-32> revision <0-65535>
```

Parameters

<1-32>	Specify the bridge group ID in the range of <1-32>.
<0-65535>	Specify a revision number in the range of <0-65535>.

Default

By default, revision number is 0

Command Mode

MST configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#spanning-tree mst configuration
(config-mst)#bridge 3 revision 25
```

bridge spanning-tree

Use this command to enable Spanning Tree Protocol (STP) globally on a bridge.

Use the `no` form of this command to disable STP globally on the bridge.

Command Syntax

```
bridge <1-32> spanning-tree enable
no bridge <1-32> spanning-tree enable (bridge-blocked|bridge-forward|)
```

Parameters

`<1-32>`	Bridge group ID.
`bridge-blocked`	Put ports of the bridge in the blocked state (default).
`bridge-forward`	Put ports of the bridge in the forwarding state.

Default

By default, this feature is enabled.

For the `no` form of this command, `bridge-blocked` is the default.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 2 spanning-tree enable

#configure terminal
(config)#no bridge 2 spanning-tree enable bridge-forward
```

bridge spanning-tree errdisable-timeout

Use this command to enable the error-disable-timeout facility, which sets a timeout for ports that are disabled due to the BPDU guard feature.

The BPDU guard feature shuts down the port on receiving a BPDU on a BPDU-guard enabled port. This command associates a timer with the feature such that the port gets enabled back without manual intervention after a set interval.

Use the `no` parameter to disable the error-disable-timeout facility.

Command Syntax

```
bridge <1-32> spanning-tree errdisable-timeout enable
bridge <1-32> spanning-tree errdisable-timeout interval <10-1000000>
no bridge <1-32> spanning-tree errdisable-timeout enable
no bridge <1-32> spanning-tree errdisable-timeout interval
```

Parameters

`<1-32>`	Specify the bridge group ID.
`enable`	Enable the timeout mechanism for the port to be enabled back
`interval`	Specify the interval after which port shall be enabled.
`<10-1000000>`	Specify the error-disable-timeout interval in seconds.

Default

By default, the port is enabled after 300 seconds

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 spanning-tree errdisable-timeout enable

#configure terminal
(config)#bridge 4 spanning-tree errdisable-timeout interval 34
```

bridge spanning-tree force-version

Use this command to set the version for the bridge. A version identifier of less than a value of 2 enforces the spanning tree protocol. Although the command supports an input range of 0-4, for RSTP, the valid range is 0-2. When the force-version is set for a bridge, all ports of the bridge have the same spanning tree version set.

Use the `show spanning tree` command to display administratively configured and currently running values of the BPDU filter parameter for the bridge and port (see show spanning-tree).

Use the no parameter with this command to disable the version for the bridge.

Command Syntax

```
bridge <1-32> spanning-tree force-version <0-4>
no bridge <1-32> spanning-tree force-version
```

Parameters

`<1-32>`	Specify the bridge group ID.
`force-version`	Specify a force version identifier:
`0`	STP
`1`	Not supported
`2`	RSTP
`3`	MSTP

Default

By default, spanning tree force version is 0

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

Set the value to enforce the spanning tree protocol:

```
#configure terminal
(config)#bridge 1 spanning-tree force-version 0

(config)#no bridge 1 spanning-tree force-version
```

bridge spanning-tree pathcost

Use this command to set a spanning-tree path cost method.

If the short parameter is used, the switch uses a value for the default path cost a number in the range 1 through 65,535. If the long parameter is used, the switch uses a value for the default path cost a number in the range 1 through 200,000,000. Refer to the show spanning-tree to view the administratively configured and current running pathcost method running on a bridge.

Use the no option with this command to return the path cost method to the default setting.

Command Syntax

```
bridge <1-32> spanning-tree pathcost method (short|long)
no bridge <1-32> spanning-tree pathcost method
```

Parameters

`<1-32>`	Specify the bridge group ID.
`method`	Method used to calculate default port path cost.
`long`	Use 16-bit based values for default port path costs.
`short`	Use 32-bit based values for default port path costs.

Default

By default, path cost method for STP is short and for MSTP/RSTP is long.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 spanning-tree pathcost method short

(config)#no bridge 1 spanning-tree pathcost method
```

bridge spanning-tree portfast

Use this command to set the portfast BPDU (Bridge Protocol Data Unit) guard or filter for the bridge.

Use the `show spanning tree` command to display administratively configured and currently running values of the BPDU filter parameter for the bridge and port (see show spanning-tree).

Use the `no` parameter with this command to disable the BPDU filter for the bridge.

BPDU Filter

All ports that have their BPDU filter set to default take the same value of BPDU filter as that of the bridge. The Spanning Tree Protocol sends BPDUs from all ports. Enabling the BPDU Filter feature ensures that PortFast-enabled ports do not transmit or receive any BPDUs.

BPDU Guard

When the BPDU guard feature is set for a bridge, all portfast-enabled ports of the bridge that have the BPDU guard set to default shut down the port on receiving a BPDU. In this case, the BPDU is not processed. You can either bring the port back up manually by using the `no shutdown` command, or configure the errdisable-timeout feature to enable the port after the specified time interval.

Command Syntax

```
bridge <1-32> spanning-tree portfast bpdu-guard
bridge <1-32> spanning-tree portfast bpdu-filter
no bridge <1-32> spanning-tree portfast bpdu-guard
no bridge <1-32> spanning-tree portfast bpdu-filter
```

Parameters

`<1-32>`	Specify the bridge group ID.
`bpdu-filter`	Specify to filter the BPDUs on portfast enabled ports.
`bpdu-guard`	Specify to guard the portfast ports against BPDU receive.

Default

By default, portfast for STP is enabled

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 3 spanning-tree portfast bpdu-filter

#configure terminal
(config)#bridge 1 spanning-tree portfast bpdu-guard
```

bridge te-msti

Use this command to enable or disable a Multiple Spanning Tree Instance (MSTI).

The te-msti always refers to the MST instance indexed by the pre-defined macro constant MSTP_TE_MSTID internally. This is the only MST instance which supports the disabling of spanning trees.

Use the no form of this command to remove the configuration.

Command Syntax

```
bridge (<1-32>) te-msti
no bridge (<1-32>) te-msti
```

Parameters

<1-32>	Specify the bridge group ID.
te-msti	MSTI to be the traffic engineering MSTI instance.

Default

By default, bridge te-msti is disabled

Command Mode

TE-MSTI Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree te-msti configuration
(config-te-msti)#bridge 2 te-msti

(config-te-msti)#no bridge 2 te-msti
```

bridge te-msti vlan

Use this command to enable or disable a Multiple Spanning Tree Instance (MSTI). When an MSTI is shutdown (disabled) each VLAN in the MSTI is set to the forwarding state on all bridge ports which the VLAN as a member of. When and MSTI is enabled (no shutdown), normal MSTP operation is started for the MSTI.

The te-msti always refers to the MST instance indexed by the pre-defined macro constant MSTP_TE_MSTID internally. This is the only MST instance which supports the disabling of spanning trees. All VLANs that do not want spanning tree topology computation need to be assigned to this te-msti instance.

This command is intended for supporting Traffic Engineering (TE) Ethernet tunnels. All VLANs allocated for traffic engineering should be assigned to one MSTI. That MSTI can in turn shutdown the spanning tree operation so that each VLAN path through the network can be manually provisioned.

Use the no form of this command to remove the configuration.

Command Syntax

```
bridge (<1-32>) te-msti vlan <1-4094>
no bridge (<1-32>) te-msti vlan <1-4094>
```

Parameters

<1-32>	Specify the bridge group ID.
vlan	Specify a VLAN.
<1-4094>	Specify a VLAN identifier to be associated.

Note: This designated instance is defined in 802.1Qay clause 8.9 to be 0xFFE.

Default

By default, te-msti vlan is vlan1.

Command Mode

TE-MSTI Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree te-msti configuration
(config-te-msti)#bridge 2 te-msti vlan 10
(config-te-msti)#no bridge 2 te-msti vlan 10
```

bridge-group instance

Use this command to assign a Multiple Spanning Tree (MST) instance to a port.

Use the `no` form of this command to remove the interface from the MST instance.

Command Syntax

```
bridge-group (<1-32>) instance (<1-63> | te-msti)
no bridge-group (<1-32>) instance (<1-63> | te-msti)
```

Parameters

`<1-32>`	Bridge identifier.
`<1-63>`	Multiple spanning tree instance identifier.
`spbm`	spbm
`spbv`	spbv
`te-msti`	Traffic engineering MSTI instance.

Default

By default, the bridge port remains in the listening and learning states for 15 seconds before transitional to the forwarding state.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#bridge-group 1
(config-if)#bridge-group 1 instance te-msti
```

bridge-group instance path-cost

Use this command to set a path cost for a multiple spanning tree instance.

Before you can give this command, you must explicitly add an MST instance to a port using the `bridge-group instance` command.

Use the `no` form of this command to set the path cost to its default which varies depending on bandwidth.

Command Syntax

```
bridge-group (<1-32>) instance <1-63> path-cost <1-200000000>
no bridge-group (<1-32>) instance <1-63> path-cost
```

Parameters

`<1-32>`	Bridge identifier.
`<1-63>`	Set the MST instance identifier.
`<1-200000000>`	Path cost for a port (a lower path cost means greater likelihood of becoming root).

Default

Assuming a 10 Mb/s link speed, the default value is 200,000.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#spanning-tree mst configuration
(config-mst)#bridge 4 instance 3 vlan 3
(config-mst)#exit
(config)#interface eth1
(config-if)#bridge-group 4 instance 3
(config-if)#bridge-group 4 instance 3 path-cost 1000
```

bridge-group instance priority

Use this command to set the priority of a multiple spanning tree instance.

The Multiple Spanning Tree Protocol uses port priority as a tiebreaker to determine which port should forward frames for a particular instance on a LAN, or which port should be the root port for an instance. A lower value implies a better priority. In the case of the same priority, the interface index will serve as the tiebreaker, with the lower-numbered interface being preferred over others.

Command Syntax

```
bridge-group (<1-32>) instance (<1-63>) priority <0-240>
no bridge-group (<1-32>) instance (<1-63>) priority
```

Parameters

<1-32>	Bridge identifier.
<1-63>	Multiple spanning tree instance identifier.
<0-240>	Port priority. A lower value means greater likelihood of becoming root. Set the port priority in increments of 16.

Default

By default, the port priority is 128

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
(config)#interface eth2
(config-if)#bridge-group 2
(config-if)#bridge-group 2 instance 4
(config-if)#bridge-group 2 instance 4 priority 64
```

bridge-group path-cost

Use this command to set the cost of a path. Before you can use this command to set a path-cost in a VLAN configuration, you must explicitly add an MST instance to a port using the `bridge-group instance` command.

Use the `no` parameter with this command to restore the default cost value of the path which varies depending on the bandwidth.

Command Syntax

```
bridge-group <1-32> path-cost <1-200000000>
no bridge-group <1-32> path-cost
```

Parameters

`<1-32>`	Specify the bridge group ID.
`path-cost`	Specify the cost of path for a port.
`<1-200000000>`	Specify the cost of the path (a lower cost means a greater likelihood of the interface becoming root).

Default

Assuming a 10 Mb/s link speed, the default value is 200,000.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree mst configuration
(config-mst)#bridge 4 instance 3 vlan 3
(config-mst)#exit
(config)#interface eth1
(config-if)#bridge-group 4
(config-if)#bridge-group 4 path-cost 1000
```

bridge-group priority

Use this command to set the port priority for a bridge group.

The Multiple Spanning Tree Protocol uses port priority as a tiebreaker to determine which port should forward frames for a particular instance on a LAN, or which port should be the root port for an instance. A lower value implies a better priority. In the case of the same priority, the interface index will serve as the tiebreaker, with the lower-numbered interface being preferred over others.

Command Syntax

```
bridge-group (<1-32>) priority <0-240>
no bridge-group (<1-32>) priority
```

Parameters

`<1-32>`	Specify the bridge group ID.
`<0-240>`	Specify the port priority (a lower priority indicates greater likelihood of the interface becoming a root). The priority values can only be set in increments of 16.

Default

By default, port priority for each instance is 128

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#bridge-group 4 priority 80
```

bridge-group spanning-tree

Use this command to enable or disable spanning-tree on an interface.

Command Syntax

```
bridge-group <1-32> spanning-tree (disable|enable)
```

Parameters

`<1-32>`	Bridge group ID.
`disable`	Disable spanning tree on the interface.
`enable`	Enable spanning tree on the interface.

Default

By default, spanning-tree is enabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
(config)#interface eth1
(config-if)#bridge-group 1 spanning-tree enable
```

clear spanning-tree detected protocols

Use this command to clear the detected protocols for a specific bridge or interface. This command begins the port migration as per IEEE 802.1w-2001, Section 17.26. After issuing this command, the migration timer is started on the port, only if the force version is RSTP or MSTP (greater versions of RSTP).

Command Syntax

```
clear spanning-tree detected protocols bridge <1-32>
```

Parameters

`<1-32>`	Specify the bridge group ID.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#clear spanning-tree detected protocols bridge 2
```

clear spanning-tree statistics

Use this command to clear all STP BPDU statistics.

Command Syntax

```
clear spanning-tree statistics bridge <1-32>
clear spanning-tree statistics interface IFNAME (instance (<1-63>)| vlan <1-4094>)
  bridge <1-32>
clear spanning-tree statistics (interface IFNAME| (instance (<1-63>)| vlan <2-
  4094>)) bridge <1-32>
```

Parameters

<1-32>	Specify the bridge identifier.
IFNAME	Specify the name of the interface on which protocols have to be cleared.
<1-63>	MST instance ID.
<1-4094>	VLAN identifier where spanning tree is located <2-4094>

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#clear spanning-tree statistics bridge 32
```

customer-spanning-tree customer-edge path-cost

Use this command to set the cost of a path associated with a customer edge port on a customer edge spanning tree.

Use the `no` form of this command to remove the cost of a path associated with a customer edge port on a customer edge spanning tree.

Command Syntax

```
customer-spanning-tree customer-edge path-cost <1-200000000>
no customer-spanning-tree customer-edge path-cost
```

Parameters

`path-cost`	Specify the path-cost of a port.
`<1-200000000>`	Specify the cost to be assigned to the group.

Default

Assuming a 10 Mb/s link speed, the default value is 200,000

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree customer-edge path-cost 1000
```

customer-spanning-tree customer-edge priority

Use this command to set the port priority for a customer-edge port in the customer spanning tree.

Command Syntax

```
customer-spanning-tree customer-edge priority <0-240>
```

Parameters

`priority`	Specify the port priority.
`<0-240>`	Specify the port priority range (a lower priority indicates greater likelihood of the interface becoming a root). The priority values can only be set in increments of 16.

Default

By default, priority is 1

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree customer-edge priority 100
```

customer-spanning-tree forward-time

Use this command to set the time (in seconds) after which (if this bridge is the root bridge) each port changes states to learning and forwarding. This value is used by all instances.

Use the `no` form of this command to restore the default value of 15 seconds.

Command Syntax

```
customer-spanning-tree forward-time <4-30>
no customer-spanning-tree forward-time
```

Parameters

`<4-30>`	Specify the forwarding time delay in seconds.

Note: Care should be exercised if the value is set to less than 7 seconds.

Default

By default, priority is 15 seconds

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree forward-time 6

(config-if)#no customer-spanning-tree forward-time
```

customer-spanning-tree hello-time

Use this command to set the hello-time, the time in seconds after which (if this bridge is the root bridge) all the bridges in a bridged LAN exchange Bridge Protocol Data Units (BPDUs). Avoid a very low value of this parameter as this can lead to excessive traffic on the network; a higher value delays the detection of topology change. This value is used by all instances.

Use the `no` option with this command to restore the default value of the hello-time.

Command Syntax

```
customer-spanning-tree hello-time <1-10>
no customer-spanning-tree hello-time
```

Parameters

`<1-10>`	Specify the hello BPDU interval in seconds.

Default

By default, level is 2 seconds

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree hello-time 3

(config-if)#no customer-spanning-tree hello-time
```

customer-spanning-tree max-age

Use this command to set the max-age for a bridge.

Max-age is the maximum time in seconds for which (if a bridge is the root bridge) a message is considered valid. This prevents the frames from looping indefinitely. The value of max-age should be greater than twice the value of hello-time plus one, but less than twice the value of forward delay minus one. The allowable range for max-age is 6-40 seconds. Configure this value sufficiently high, so that a frame generated by a root can be propagated to the leaf nodes without exceeding the max-age.

Use the `no` parameter with this command to restore the default value of max-age.

Command Syntax

```
customer-spanning-tree max-age <6-40>
no customer-spanning-tree max-age
```

Parameters

`<6-40>`	Specify the maximum time in seconds to listen for the root bridge.

Default

By default, bridge max-age is 20 seconds

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree max-age 12

(config-if)#no customer-spanning-tree max-age
```

customer-spanning-tree priority

Use this command to set the bridge priority for the spanning tree on a customer edge port. Using a lower priority indicates a greater likelihood of the bridge becoming root. This command must be used to set the priority of the customer spanning tree running on the customer edge port.

Use the `no` form of the command to reset it to the default value.

Command Syntax

```
customer-spanning-tree priority <0-61440>
no customer-spanning-tree priority
```

Parameters

`<0-61440>`	Specify the bridge priority in the range <0-61440>. Priority values can be set only in increments of 4096.

Default

By default, priority is 61440

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree priority 4096

(config-if)#no customer-spanning-tree priority
```

customer-spanning-tree provider-edge path-cost

Use this command to set the cost of a path associated with a provider edge port on a customer edge spanning tree.

Use the `no` form of this command to remove the cost of a path associated with a provider edge port on a customer edge spanning tree.

Command Syntax

```
customer-spanning-tree provider-edge svlan <1-4094> path-cost <1-200000000>
no customer-spanning-tree provider-edge svlan <1-4094> path-cost
```

Parameters

`<1-4094>`	Specify the SVLAN identifier of provider edge port.
`<1-200000000>`	Specify the cost to be assigned to the group.

Default

Assuming a 10 Mb/s link speed, the default value is 200,000

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree provider-edge svlan 2 path-cost 1000

(config-if)#no customer-spanning-tree provider-edge svlan 2 path-cost
```

customer-spanning-tree provider-edge priority

Use this command to set the port priority for a provider-edge port in the customer spanning tree.

Command Syntax

```
customer-spanning-tree provider-edge svlan <1-4094> priority <0-240>
```

Parameters

`<1-4094>`	Specify the SVLAN identifier of provider edge port.
`<0-240>`	Specify the port priority (a lower priority means greater likelihood of the interface becoming root). The priority values can only be set in increments of 16.

Default

By default, priority is 1

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree provider-edge svlan 2 priority 0
```

customer-spanning-tree transmit-holdcount

Use this command to set the transmit-holdcount for a bridge.

Use the `no` parameter with this command to restore the default value of `transmit-holdcount`.

Command Syntax

```
customer-spanning-tree transmit-holdcount <1-10>
no customer-spanning-tree transmit-holdcount
```

Parameters

`<1-10>`	Specify the maximum number that can be transmitted per second.

Default

By default, bridge transmit hold count is 6

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#customer-spanning-tree transmit-holdcount 3

(config-if)#no customer-spanning-tree transmit-holdcount
```

debug mstp

Use this command to turn on, and turn off, debugging and echoing data to the console, at various levels.

Note: This command enables MSTP, RSTP, and STP debugging.

Use the `no` parameter with this command to turn off debugging.

Command Syntax

```
debug mstp all
debug mstp cli
debug mstp packet rx
debug mstp packet tx
debug mstp protocol
debug mstp protocol detail
debug mstp timer
debug mstp timer detail
no debug mstp all
no debug mstp cli
no debug mstp packet rx
no debug mstp packet tx
no debug mstp protocol
no debug mstp protocol detail
no debug mstp timer
no debug mstp timer detail
```

Parameters

`all`	Echoes all spanning-tree debugging levels to the console.
`cli`	Echoes spanning-tree commands to the console.
`packet`	Echoes spanning-tree packets to the console.
`rx`	Received packets.
`tx`	Transmitted packets.
`protocol`	Echoes protocol changes to the console.
`detail`	Detailed output.
`timer`	Echoes timer start to the console.
`detail`	Detailed output.

Command Mode

Exec, Privileged Exec, and Configure modes

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#debug mstp all
(config)#debug mstp cli
(config)#debug mstp packet rx
(config)#debug mstp protocol detail
(config)#debug mstp timer
```

show debugging mstp

Use this command to display the status of debugging of the MSTP system.

Command Syntax

```
show debugging mstp
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#show debugging mstp
MSTP debugging status:
MSTP debugging status:
 MSTP timer debugging is on
 MSTP protocol debugging is on
 MSTP detailed protocol debugging is on
 MSTP cli echo debugging is on
 MSTP transmitting packet debugging is on
 MSTP receiving packet debugging is on
#
```

show spanning-tree

Use this command to show the state of the spanning tree for all STP or RSTP bridge-groups, including named interface and VLANs.

Command Syntax

```
show spanning-tree
show spanning-tree interface IFNAME
show spanning-tree mst
show spanning-tree mst config
show spanning-tree mst interface IFNAME
show spanning-tree mst detail
show spanning-tree mst detail interface IFNAME
show spanning-tree mst instance (<1-63>) interface IFNAME
show spanning-tree mst instance (<1-63> | te-msti)
show spanning-tree statistics bridge <1-32>
show spanning-tree statistics interface IFNAME (instance (<1-63>)| vlan <2-4094>)
  bridge <1-32>
show spanning-tree statistics (interface IFNAME | (instance (<1-63>) | vlan <1-
  4094>)) bridge <1-32>
show spanning-tree vlan range-index
```

Parameters

`interface`	Display interface information
`mst`	Display MST information
`statistics`	Display statistics of the BPDUs
`vlan range-index`	Display a VLAN range-index value
`config`	Display configuration information
`detail`	Display detailed information
`instance`	Display instance information
`<1-63>`	Specify the instance identifier
`te-msti`	Display Traffic Engineering MSTI instance
`<1-32>`	Specify the bridge identifier
`IFNAME`	Display the interface name
`<2-4094>`	Specify a VLAN identifier, associated with the instance

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following is a sample output of this command displaying spanning tree information.

```
#show spanning-tree
% 1: Bridge up - Spanning Tree Enabled
% 1: Root Path Cost 0 - Root Port 0 - Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20
% 1: Root Id 80000002b328530a
% 1: Bridge Id 80000002b328530a
% 1: last topology change Wed Nov 19 22:39:18 2008
% 1: 11 topology change(s) - last topology change Wed Nov 19 22:39:18 2008
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%eth2: Ifindex 5 - Port Id 8005 - Role Designated - State Forwarding
%eth2: Designated Path Cost 0
%eth2: Configured Path Cost 200000 - Add type Explicit ref count 1
%eth2: Designated Port Id 8005 - Priority 128 -
%eth2: Root 80000002b328530a
%eth2: Designated Bridge 80000002b328530a
%eth2: Message Age 0 - Max Age 20
%eth2: Hello Time 2 - Forward Delay 15
%eth2: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change timer 0
%eth2: forward-transitions 4
%eth2: Version Rapid Spanning Tree Protocol - Received RSTP - Send RSTP
%eth2: No portfast configured - Current portfast off
%eth2: portfast bpdu-guard default - Current portfast bpdu-guard off
%eth2: portfast bpdu-filter default - Current portfast bpdu-filter off
%eth2: no root guard configured- Current root guard off
%eth2: Configured Link Type point-to-point - Current point-to-point
%eth1: Ifindex 4 - Port Id 8004 - Role Designated - State Forwarding
%eth1: Designated Path Cost 0
%eth1: Configured Path Cost 200000 - Add type Explicit ref count 1
%eth1: Designated Port Id 8004 - Priority 128 -
%eth1: Root 80000002b328530a
%eth1: Designated Bridge 80000002b328530a
%eth1: Message Age 0 - Max Age 20
%eth1: Hello Time 2 - Forward Delay 15
%eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change timer 0
%eth1: forward-transitions 4
%eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%eth1: No portfast configured - Current portfast off
%eth1: portfast bpdu-guard default - Current portfast bpdu-guard off
%eth1: portfast bpdu-filter default - Current portfast bpdu-filter off
%eth1: no root guard configured- Current root guard off
%eth1: Configured Link Type point-to-point - Current point-to-point
%
%
```

The following is a sample output of this command displaying the state of the spanning tree for interface `eth1`.

```
#show spanning-tree interface eth1
```

```
% 1: Bridge up - Spanning Tree Enabled
% 1: Root Path Cost 0 - Root Port 0 - Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20
% 1: Root Id 80000002b328530a
% 1: Bridge Id 80000002b328530a
% 1: last topology change Wed Nov 19 22:39:18 2008
% 1: 11 topology change(s) - last topology change Wed Nov 19 22:39:18 2008
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
% eth1: Ifindex 4 - Port Id 8004 - Role Designated - State Forwarding
% eth1: Designated Path Cost 0
% eth1: Configured Path Cost 200000 - Add type Explicit ref count 1
% eth1: Designated Port Id 8004 - Priority 128 -
% eth1: Root 80000002b328530a
% eth1: Designated Bridge 80000002b328530a
% eth1: Message Age 0 - Max Age 20
% eth1: Hello Time 2 - Forward Delay 15
% eth1: forward-transitions 4
% eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
% eth1: No portfast configured - Current portfast off
% eth1: portfast bpdu-guard default - Current portfast bpdu-guard off
% eth1: portfast bpdu-filter default - Current portfast bpdu-filter off
% eth1: no root guard configured- Current root guard off
```

Table 3-5 Explains the show command output fields.

Table 3-5: show spanning-tree interface output fields

Table 3-6:

Field	Description
Bridge up	A network bridge is a computer networking device that creates a single aggregate network from multiple communication networks or network segments.
Root Path Cost	Root cost for the interface.
Root Port	Interface that is the current elected root port for this bridge.
Bridge Priority	Used for the common instance.
Forward Delay	Configured time an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.
Hello Time	Configured number of seconds between transmissions of configuration BPDUs.
Max Age	Maximum age of received protocol BPDUs.
Port Id	Logical interface identifier configured to participate in the MSTP instance.
Role Designated	Designated role for the packets in the interface.
State Forwarding	State of the forwarding packets in the interface.
Designated Path Cost	Designated cost for the interface.

Table 3-6:

Field	Description
Configured Path Cost	Configured cost for the interface.
Designated Port Id	Port ID of the designated port for the LAN segment this interface is attached to.
Priority	Specify the port priority.
Message Age	Number of seconds elapsed since the most recent BPDU was received.
Forward Timer	The forward delay timer is the time interval that is spent in the listening and learning state.
Msg Age Timer	The message age contains the length of time that has passed since the root bridge initially originated the BPDU.
Received RSTP	Number of times the received the RSTP.
Send RSTP	Number of times transmitted the RSTP.

show spanning-tree mst

Use this command to display the filtering database values. This command displays the number of instances created, and VLANs associated with it.

Command Syntax

```
show spanning-tree mst
show spanning-tree mst config
show spanning-tree mst detail
show spanning-tree mst detail interface IFNAME
show spanning-tree mst instance (<1-63>) interface IFNAME
show spanning-tree mst instance (<1-63> | te-msti)
show spanning-tree mst interface IFNAME
```

Parameters

`config`	Display configuration information.
`detail`	Display detailed information.
`interface`	Display interface information.
`instance`	Display instance information.
`<1-63>`	Specify the instance identifier.
`te-msti`	Traffic Engineering MSTI instance.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#show spanning-tree mst
% 1: Bridge up - Spanning Tree Enabled
% 1: CIST Root Path Cost 0 - CIST Root Port 0 - CIST Bridge
Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Max-hops 20
% 1: CIST Root Id 80000002b328530a
% 1: CIST Reg Root Id 80000002b328530a
% 1: CIST Bridge Id 80000002b328530a
% 1: 2 topology change(s) - last topology change Wed Nov 19 22:43:21 2008
% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec%
% Instance VLAN
% 0:        1
% 2:        3-4
```

Table 3-7 Explains the show command output fields.

Table 3-7: show spanning-tree mst output fields

Table 3-8:

Field	Description
Bridge up	A network bridge is networking process that creates a single aggregate network from multiple communication networks or network segments.
CIST Root Path Cost	Calculated cost to reach the regional root bridge from the bridge where the command is entered.
CIST Root Port	Interface that is the current elected CIST root port for this bridge.
CIST Bridge	A CIST bridge is networking process that creates a single aggregate network from multiple communication networks.
Priority	Specify the port priority.
Forward Delay	Configured time an STP bridge port remains in the listening and learning states before transitioning to the forwarding state.
Hello Time	Configured number of seconds between transmissions of configuration BPDUs.
Max Age	Maximum age of received protocol BPDUs.
Max-hops	Configured maximum number of hops a BPDU can be forwarded in the MSTP region.

show spanning-tree statistics

Use this command to display detailed BPDU statistics for a spanning tree instance.

Command Syntax

```
show spanning-tree statistics bridge <1-32>
show spanning-tree statistics interface IFNAME (instance (<1-63>)| vlan <2-4094>)
  bridge <1-32>
show spanning-tree statistics (interface IFNAME | (instance (<1-63>) | vlan <1-
  4094>)) bridge <1-32>
```

Parameters

`<1-32>`	Bridge identifier.
`<1-63>`	MST instance identifier.
`IFNAME`	Displays the interface name.
`<2-4094>`	Specify a VLAN identifier, associated with the instance.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

In the following example, bridge-group 1 is configured for IEEE on the eth2 interface.

```
#show spanning-tree statistics interface eth2 bridge 1

% BPDU Related Parameters
% ----------------------
% Port Spanning Tree                : Enable
% Spanning Tree Type                : Spanning Tree Protocol
% Current Port State                : Learning
% Port ID                           : 8004
% Port Number                       : 4
% Path Cost                         : 200000
% Message Age                       : 0
% Designated Root                   : 00:02:b3:d5:91:ec
% Designated Cost                   : 0
% Designated Bridge                 : 00:02:b3:d5:91:ec
% Designated Port Id                : 8005
% Top Change Ack                    : FALSE
% Configure Pending                    : FALSE

% PORT Based Information & Statistics
% ----------------------------------
% Configure Bpdu's xmitted             : 0
% Configure Bpdu's received            : 22
% TCN Bpdu's xmitted                : 0
```

```
% TCN Bpdu's received                : 8
% Forward Trans Count                : 0

% STATUS of Port Timers
% --------------------
% Hello Time Configured               : 2
% Hello timer                        : ACTIVE
% Hello Time Value                   : 1
% Forward Delay Timer                : ACTIVE
% Forward Delay Timer Value          : 1
% Message Age Timer                  : ACTIVE
% Message Age Timer Value            : 19
% Topology Change Timer              : INACTIVE
% Topology Change Timer Value        : 0
% Hold Timer                         : INACTIVE
% Hold Timer Value                   : 0

% Other Port-Specific Info
  ------------------------
% Max Age Transitions                : 1
% Msg Age Expiry                     : 0
% Similar BPDUS Rcvd                 : 14
% Src Mac Count                      : 0
% Total Src Mac Rcvd                 : 15
% Next State                         : Blocked
% Topology Change Time               : 0


% Other Bridge information & Statistics
  -------------------------------------
% STP Multicast Address              : 01:80:c2:00:00:00
% Bridge Priority                    : 32768
% Bridge Mac Address                 : 00:02:b3:d5:98:3f
% Bridge Hello Time                  : 2
% Bridge Forward Delay               : 15
% Topology Change Initiator          : 0
% Last Topology Change Occurred       : Wed Dec 31 16:00:00 1969
% Topology Change                    : FALSE
% Topology Change Detected           : FALSE
% Topology Change Count              : 0
% Topology Change Last Recvd from    : 00:00:00:00:00:00
```

Table 3-9 Explains the show command output fields.

Table 3-9: show spanning-tree statistics output fields

Table 3-10:

Field	Description
BPDU Related Parameters	Details of the BPDU related parameters.
PORT Based Information & Statistics	Information of the port and interface for which the statistics are being displayed.

Table 3-10:

Field	Description
STATUS of Port Timers	Status of the port timers.
Other Port-Specific Info	Specific information about the port.
Other Bridge information & Statistics	Information about bridge and statistics being displayed.

snmp restart mstp

Use this command to restart SNMP in Multiple Spanning Tree Protocol (MSTP).

Command Syntax

```
snmp restart mstp
```

Parameters

None

Default

No default value is specified

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#snmp restart mstp
```

spanning-tree autoedge

Use this command to assist in automatic identification of the edge port.

Use the `no` parameter with this command to disable this feature.

Command Syntax

```
spanning-tree autoedge
no spanning-tree autoedge
```

Default

By default, spanning-tree autoedge is disabled

Parameters

None

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree autoedge
```

spanning-tree edgeport

Use this command to set a port as an edge-port and to enable rapid transitions.

Use the `no` parameter with this command to set a port to its default state (not an edge-port) and to disable rapid transitions.

Note: This command is an alias to the `spanning-tree portfast` command. Both commands can be used interchangeably.

Command Syntax

```
spanning-tree edgeport
no spanning-tree edgeport
```

Default

By default, spanning-tree edgeport is disabled

Parameters

None

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree edgeport
```

spanning-tree guard

Use this command to enable the root guard feature for the port. This feature disables reception of superior BPDUs.

The root guard feature makes sure that the port on which it is enabled is a designated port. If the root guard enabled port receives a superior BPDU, it goes to a Listening state (for STP) or discarding state (for RSTP and MSTP).

Use the `no` parameter with this command to disable the root guard feature for the port.

Command Syntax

```
spanning-tree guard root
no spanning-tree guard root
```

Parameters

`root`	Set to disable reception of superior BPDUs

Default

By default, spanning-tree guard root is enabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree guard root
```

spanning-tree instance restricted-role

Use this command to set the restricted role value for the instance to TRUE.

Use the `no` parameter with this command to set the restricted role value for the instance to FALSE.

Command Syntax

```
spanning-tree instance <1-63> restricted-role
no spanning-tree instance <1-63> restricted-role
```

Parameters

`<1-63>`	Specify the instance ID range.

Default

By default, restricted-role value is FALSE

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree instance 2 restricted-role
```

spanning-tree instance restricted-tcn

Use this command to set the restricted TCN value for the instance to TRUE.

Command Syntax

```
spanning-tree instance <1-63> restricted-tcn
no spanning-tree instance <1-63> restricted
```

Parameters

<1-63>	Specify the instance ID range.

Default

By default, restricted TCN value is FALSE

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree instance 2 restricted-tcn
```

spanning-tree link-type

Use this command to enable or disable point-to-point or shared link types.

RSTP has a backward-compatible STP mode, `spanning-tree link-type shared`. An alternative is the `spanning-tree force-version 0`.

Use the `no` parameter with this command to disable rapid transition.

Command Syntax

```
spanning-tree link-type auto
spanning-tree link-type point-to-point
spanning-tree link-type shared
no spanning-tree link-type
```

Parameters

`auto`	Sets to either point-to-point or shared based on duplex state.
`point-to-point`	Enables rapid transition.
`shared`	Disables rapid transition.

Default

By default, spanning-tree link-type is enabled.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree link-type point-to-point

(config-if)#no spanning-tree link-type
```

spanning-tree mst configuration

Use this command to enter the Multiple Spanning Tree Configuration mode.

Command Syntax

```
spanning-tree mst configuration
```

Parameters

None

Default

No default value is specified.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree mst configuration
(config-mst)#
```

spanning-tree bpdu-filter

Use this command to set the BPDU filter value for individual ports. When the `enable` or `disable` parameter is used with this command, this configuration takes precedence over bridge configuration. However, when the `default` parameter is used with this command, the bridge level BPDU filter configuration takes effect for the port.

Use the `show spanning tree` command to display administratively configured and currently running values of the BPDU filter parameter for the bridge and port (see show spanning-tree).

Use the `no` parameter with this command to revert the port BPDU filter value to default.

Command Syntax

```
spanning-tree bpdu-filter (enable|disable|default)
no spanning-tree bpdu-filter
```

Parameters

`default`	Sets the bpdu-filter to the default level.
`disable`	Disables the BPDU-filter.
`enable`	Enables the BPDU-filter.

Default

By default, spanning-tree bpdu-filter is default option

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree bpdu-filter enable

(config-if)#no spanning-tree bpdu-filter
```

spanning-tree bpdu-guard

Use this command to enable or disable the BPDU Guard feature on a port.

This command supersedes the bridge level configuration for the BPDU Guard feature. When the `enable` or `disable` parameter is used with this command, this configuration takes precedence over bridge configuration. However, when the `default` parameter is used with this command, the bridge-level BPDU Guard configuration takes effect.

Use the `show spanning tree` command to display administratively configured and currently running values of the BPDU filter parameter for the bridge and port (see show spanning-tree).

Use the no parameter with this command to set the BPDU Guard feature on a port to default.

Command Syntax

```
spanning-tree bpdu-guard (enable|disable|default)
no spanning-tree bpdu-guard
```

Parameters

`default`	Sets the BPDU-guard to the default level.
`disable`	Disables the BPDU-guard.
`enable`	Enables the BPDU-guard.

Default

By default, spanning-tree bpdu-guard is default

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree bpdu-guard enable

(config-if)#no spanning-tree bpdu-guard
```

spanning-tree restricted-domain-role

Use this command to set the restricted-domain-role value of the port to TRUE.

Use the `no` parameter with this command to set the restricted-domain-role value of the port to FALSE.

Command Syntax

```
spanning-tree restricted-domain-role
no spanning-tree restricted-domain-role
```

Parameters

None

Default

By default, restricted-role value is FALSE

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree restricted-domain-role
```

spanning-tree restricted-role

Use this command to set the restricted-role value of the port to TRUE.

Use the `no` parameter with this command to set the restricted-role value of the port to FALSE.

Command Syntax

```
spanning-tree restricted-role
no spanning-tree restricted-role
```

Parameters

None

Default

By default, restricted-role value is FALSE

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree restricted-role
```

spanning-tree restricted-tcn

Use this command to set the restricted TCN value of the port to TRUE.

Use the `no` parameter with this command to set the restricted TCN value of the port to FALSE.

Command Syntax

```
spanning-tree restricted-tcn
no spanning-tree restricted-tcn
```

Parameters

None

Default

By default, restricted TCN value is FALSE

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree restricted-tcn
```

spanning-tree te-msti configuration

This command is used to put the terminal into the `te-msti` configuration mode.

After creating a bridge instance and adding VLAN to that bridge instance, use this command to enter `te-msti` configuration mode.

Command Syntax

```
spanning-tree te-msti configuration
```

Parameters

None

Default

No default value is specified

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree te-msti configuration
(config-te-msti)#
```

storm-control

Use this command to set the rising threshold level for broadcast, multicast, or destination lookup failure traffic. The storm control action occurs when traffic utilization reaches this level.

Storm control is used to block the forwarding of unnecessary flooded traffic. A packet storm occurs when a large number of broadcast packets are received on a port. Forwarding these packets can cause the network to slow down or time out.

Storm-control is a physical interface property and when configured on port-channel storm-control is applied on each physical member port and therefore the actual value is the configured value multiplied by the number of active member interfaces.

Use the `no` form of this command to disable storm control.

Note: Minimum granularity for storm-control is 64kbps.

Note: Storm Discard notification is sent in case of packet discards but not based on configuration.

Command Syntax

```
storm-control (broadcast|multicast|dlf) (level LEVEL | <0-1000000000>
  (kbps|mbps|gbps))
no storm-control (broadcast|multicast|dlf)
```

Parameters

`broadcast`	Broadcast rate limiting.
`multicast`	Multicast rate limiting.
`dlf`	Destination lookup failure limiting.
`level`	Sets the percentage of the threshold.
`LEVEL`	The percentage of the threshold.
`<0-1000000000>`	Sets absolute threshold value <0-1000000000>
`kbps`	specifies the units of Kilobits per second.
`mbps`	specifies the units of Megabits per second.
`gbps`	specifies the units of Gigabits per second.

Default

By default, storm control is disabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#storm-control broadcast level 30
```

```
(config)#interface eth0
(config-if)#storm-control multicast level 30

(config)#interface eth0
(config-if)#storm-control multicast 300 mbps

(config)#interface eth0
(config-if)#no storm-control multicast
```

CHAPTER 4 RPVST+ Commands

This chapter contains the commands used for Rapid Per VLAN Spanning Tree (RPVST+). RPVST+ enables a bridge to inter-operate with Cisco RPVST+ switches.

RPVST+ uses the Multiple Spanning Tree Protocol (MSTP) with a single VLAN for each Multiple Spanning Tree instance (MSTI). The MST bridges can have different spanning-tree topologies for different VLANs inside a region of similar MST bridges. MSTP, like the Rapid Spanning Tree Protocol (RSTP), provides rapid reconfiguration capabilities and supports load balancing.

This chapter includes the following commands:

bridge vlan

This command creates or deletes a mapping between an MSTI (Multiple Spanning Tree Instance) and a VLAN for RPVST+ operation. There can be only one VLAN per MST instance if the bridge is configured to run in RPVST+ mode.

The VLAN must have already been created. Spanning tree is enabled on each configured VLAN, and one instance of spanning-tree runs on each configured VLAN.

Use the `no` form of the command to disable this functionality.

Command Syntax

```
bridge <1-32> vlan <2-4094>
no bridge <1-32> vlan <2-4094>
```

Parameters

`<1-32>`	Bridge identifier.
`<2-4094>`	VLAN identifier.

Command Mode

RPVST+ configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#spanning-tree rpvst+ configuration
(config-rpvst+)#bridge 1 vlan 2
(config-rpvst+)#no bridge 1 vlan 2
```

bridge vlan priority

This command sets the priority value for the spanning-tree on the bridge. The lower the priority of the VLAN on a bridge, the better the chances of the bridge becoming a root bridge, or a designated bridge for the VLAN.

Use the `no` form of this command to set the priority to its default (32,768).

Command Syntax

```
bridge <1-32> vlan <2-4094> priority <0-61440>
no bridge <1-32> vlan <2-4094> priority
```

Parameters

`<1-32>`	Bridge identifier.
`<2-4094>`	VLAN identifier.
`<0-61440>`	Bridge priority for the common instance. Set the priority in increments of 4096. A lower priority indicates greater likelihood of becoming root.

Default

By default, priority for each VLAN is 32,768

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 vlan 2 priority 80
(config)#no bridge 1 vlan 10 priority
```

bridge-group vlan

Use this command to assign a Rapid Per-VLAN Spanning Tree (RPVST+) instance to a port.

RPVST+ uses port priority as a tiebreaker to determine which port should forward frames for a particular LAN, or which port should be the root port for a VLAN. A lower value implies a better priority. In the case of the same priority, the interface index serves as the tiebreaker, with a lower-numbered interface being preferred over others.

Use the `no` parameter with this command to remove an RPVST+ instance from this port.

Command Syntax

```
bridge-group <1-32> vlan <2-4094>
bridge-group <1-32> vlan <2-4094> path-cost <1-200000000>
bridge-group <1-32> vlan <2-4094> priority <0-240>
no bridge-group <1-32> vlan <2-4094>
no bridge-group <1-32> vlan <2-4094> path-cost
no bridge-group <1-32> vlan <2-4094> priority
```

Parameters

`<1-32>`	Bridge group identifier.
`<2-4094>`	VLAN identifier.
`<1-200000000>`	Cost of a path associated with the interface.
`<0-240>`	Port priority. A lower priority indicates greater likelihood of the interface becoming a root. Set the priority only in increments of 16.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#bridge-group 1 vlan 10

(config)#interface eth1
(config-if)#bridge-group 1 vlan 10 path-cost 1000

(config-if)#no bridge-group 1 vlan 10 path-cost

(config)#interface eth1
(config-if)#bridge-group 1 vlan 10 priority 240

(config-if)#no bridge-group 1 vlan 10 priority
```

bridge protocol rpvst+

Use this command to enable Rapid Per-VLAN Spanning Tree on a bridge.

Command Syntax

```
bridge <1-32> protocol rpvst+
```

Parameter

<1-32>	Bridge identifier.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 1 protocol rpvst+
```

bridge rapid-pervlan-spanning-tree

Use this command to enable Rapid Per-VLAN Spanning Tree (RPVST+) globally on a bridge.

Use the `no` form of this command to disable RPVST+ globally on a bridge.

Command Syntax

```
bridge <1-32> rapid-pervlan-spanning-tree enable
no bridge <1-32> rapid-pervlan-spanning-tree enable (bridge-blocked|bridge-
  forward|)
```

Parameters

`<1-32>`	Bridge identifier.
`bridge-blocked`	Put ports of the bridge in the blocked state (default).
`bridge-forward`	Put ports of the bridge in the forwarding state.

Default

By default, this feature is enabled.

For the `no` form of this command, `bridge-blocked` is the default.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#bridge 1 rapid-pervlan-spanning-tree enable

(config)#no bridge 1 rapid-pervlan-spanning-tree enable bridge-forward
```

show spanning-tree rpvst+

Use this command to display RPVST information.

Command Syntax

```
show spanning-tree rpvst+
show spanning-tree rpvst+ config
show spanning-tree rpvst+ detail
show spanning-tree rpvst+ detail interface IFNAME
show spanning-tree rpvst+ interface IFNAME
show spanning-tree rpvst+ vlan <1-4094>
show spanning-tree rpvst+ vlan <1-4094> interface IFNAME
```

Parameters

`config`	Display configuration information.
`detail`	Display detailed information.
`IFNAME`	Display interface information.
`<1-4094>`	Display VLAN information

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following displays output of this command without any parameters.

```
#show spanning-tree rpvst+
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8001525400b092de
% 1: Bridge Id 8001525400b092de
% 1: last topology change Wed Mar 28 02:31:50 2018
% 1: 1 topology change(s)  - last topology change Wed Mar 28 02:31:50 2018

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 0
%   eth1: Configured Path Cost 200000  - Add type Explicit ref count 2
%   eth1: Designated Port Id 0x8003 - Priority 128  -
```

```
%   eth1: Root 8001525400b092de
%   eth1: Designated Bridge 8001525400b092de
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 3 - topo change timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%
%
%   Instance        VLAN
%   0:              1, 4-10
%   1:              2
%   2:              3
```

The following displays output of this command with the `config` parameter.

```
#show spanning-tree rpvst+ config
%
%  RPVST Configuration Information for bridge 1 :
%-------------------------------------------------------
%  Format Id      : 0
%  Name           : Default
%  Revision Level : 0
%  Digest         : 0xB41829F9030A054FB74EF7A8587FF58D
%-------------------------------------------------------

#show spanning-tree rpvst+ detail
% 1: Bridge up - Spanning Tree Enabled  - topology change detected
% 1: Root Path Cost 0 - Root Port 0 -  Bridge Priority 32768
% 1: Forward Delay 15 - Hello Time 2 - Max Age 20 - Transmit Hold Count 6
% 1: Root Id 8001525400b092de
% 1: Bridge Id 8001525400b092de
% 1: last topology change Wed Mar 28 02:31:50 2018
% 1: 1 topology change(s)  - last topology change Wed Mar 28 02:31:50 2018

% 1: portfast bpdu-filter disabled
% 1: portfast bpdu-guard disabled
% 1: portfast errdisable timeout disabled
% 1: portfast errdisable timeout interval 300 sec
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated External Path Cost 0 -Internal Path Cost 0
%   eth1: Configured Path Cost 200000  - Add type Explicit ref count 2
%   eth1: Designated Port Id 0x8003 - Priority 128  -
%   eth1: Root 8001525400b092de
```



```
%   eth1: Designated Bridge 8001525400b092de
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1 - topo change timer 0
%   eth1: forward-transitions 1
%   eth1: Version Rapid Spanning Tree Protocol - Received None - Send RSTP
%   eth1: No portfast configured - Current  portfast off
%   eth1: bpdu-guard  default  - Current bpdu-guard off
%   eth1: bpdu-filter default  - Current bpdu-filter off
%   eth1: no root guard configured     - Current root guard off
%   eth1: Configured Link Type point-to-point - Current point-to-point
%   eth1: No auto-edge configured - Current port Auto Edge off
%

% Instance  1:  Vlans: 2
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8002525400b092de
%   eth1: Designated Bridge 8002525400b092de
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1

#show spanning-tree rpvst+ vlan 2
% vlan 2 Instance 1 configured
% 1: Root Path Cost 0 - Root Port 0 - Bridge Priority 32768
% 1: Root Id 8002525400b092de
% 1: Bridge Id 8002525400b092de
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8002525400b092de
%   eth1: Designated Bridge 8002525400b092de
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 1
%

%
#show spanning-tree rpvst+ vlan 2 interface eth1
% 1: Root Path Cost 0 - Root Port 0 - Bridge Priority 32768
% 1: Root Id 8002525400b092de
```

```
% 1: Bridge Id 8002525400b092de
%   eth1: Port Number 3 - Ifindex 3 - Port Id 0x8003 - Role Designated - State
Forwarding
%   eth1: Designated Internal Path Cost 0  - Designated Port Id 0x8003
%   eth1: Configured Internal Path Cost 200000
%   eth1: Configured External Path cost 200000
%   eth1: Configured Internal Priority 128
%   eth1: Configured External Priority 128
%   eth1: Designated Root 8002525400b092de
%   eth1: Designated Bridge 8002525400b092de
%   eth1: Message Age 0 - Max Age 20
%   eth1: Hello Time 2 - Forward Delay 15
%   eth1: Forward Timer 0 - Msg Age Timer 0 - Hello Timer 0
%
```

spanning-tree rpvst+ configuration

Use this command to enter RPVST+ configuration mode after creating a bridge and adding a VLAN to that bridge.

Internally, an RSTP Instance is created for each configured VLAN.

Command Syntax

```
spanning-tree rpvst+ configuration
```

Parameters

None

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#spanning-tree rpvst+ configuration
(config-rpvst+)#
```

spanning-tree vlan restricted-role

Use this command to restrict the role of the interface.

Use the `no` form of this command to not restrict the role of the interface.

Command Syntax

```
spanning-tree vlan <2-4094> restricted-role
no spanning-tree vlan <2-4094> restricted-role
```

Parameters

`<2-4094>`	VLAN identifier.

Default

The default is to not restrict the role of the interface

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree vlan 10 restricted-role
```

spanning-tree vlan restricted-tcn

Use this command to restrict propagating topology change notifications (TCNs) from the interface.

Use the `no` form of this command to not restrict propagating TCNs from the interface.

Command Syntax

```
spanning-tree vlan <2-4094> restricted-tcn
no spanning-tree vlan <2-4094> restricted_tcn
```

Parameters

`<2-4094>`	VLAN identifier.

Default

The default is to not restrict propagating TCNs

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#spanning-tree vlan 10 restricted-tcn
(config-if)#no spanning-tree vlan 10 restricted_tcn
```

CHAPTER 5 Link Aggregation Commands

This chapter describes the link aggregation commands.

channel-group mode

Use this command to add an interface to an existing link aggregation group.

After you execute this command, the interface loses its properties and takes the properties of the aggregated interface.

Use the `no` parameter with this command to remove an interface from a dynamic link aggregation group. When you remove an interface from a LAG, the interface acquires the default interface properties.

Command Syntax

```
channel-group <1-65535> mode (active|passive)
channel-group <1-16383> mode (active|passive)
no channel-group
```

Parameters

`<1-65535>`	Specify a channel group number (without DRNI).
`<1-16383>`	Specify a channel group number (with DRNI).
`mode`	Specify a channel mode.
`active`	Enable LACP negotiation.
`passive`	Disable LACP negotiation.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#channel-group 1 mode active
(config-if)#exit

#sh run in po1
!
interface po1
 switchport
 port-channel load-balance src-dst-mac
```

The is an example of `no channel-group`:

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#no channel-group
(config-if)#exit

#sh run in xe1
!
interface xe1
```

```
!
#sh run in po1
!
interface po1
 switchport
 port-channel load-balance src-dst-mac
!
```

clear lacp

Use this command to clear the counters of all LACP aggregators or a given LACP aggregator.

Command Syntax

```
clear lacp <1-65535> counters
clear lacp counters
```

Parameters

`<1-65535>`	Clears a channel-group number.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#clear lacp 2 counters
```

debug lacp

Use this command to enable LACP debugging.

Use the `no` parameter with this command to disable debugging.

Command Syntax

```
debug lacp (event|cli|timer|packet|sync|ha|all|rx|tx)
no debug lacp (event|cli|timer|packet|sync|ha|allrx|tx)
undebug all
```

Parameters

`all`	Enables all LACP debugging.
`cli`	Echo commands to console.
`event`	Sets the debug options for LACP events.
`ha`	Echo High availability events to console.
`packet`	Sets the debug option for LACP packets.
`sync`	Echo synchronization to console.
`timer`	Echo timer expiry to console.
`rx`	Echo receiving of lacpdus to console.
`tx`	Echo transmission of lacpdus to console.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#debug lacp all
```

interface po

Use this command to create a dummy dynamic link aggregate interface (by default an L3 LAG interface).

Use the `no` form of this command to remove a dynamic link aggregate group and also it remove the properties of the po from all member ports.

Note: Switchport/routed mode needs to be set for the PO before adding member ports to it.

Command Syntax

```
interface po<1-16383>
no interface po<1-16383>
```

Parameters

`<1-16383>`	Channel group number

Default

By default, interface po is L3 LAG interface

Command Mode

Configuration mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface po1
(config-if)#switchport
(config-if)#exit
```

interface sa

Use this command to create a dummy static link aggregate interface (by default an L3 LAG interface) and to add an interface to an existing static link aggregation group.

Use the `no` form of this command to remove a static link aggregate group and also remove the properties of the po from all member ports.

Command Syntax

```
interface sa<1-16383>
no interface sa<1-16383>
```

Parameters

`<1-16383>`	Channel group number.

Default

By default, interface sa is L3 LAG interface

Command Mode

Configuration mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface sa1
(config-if)#switchport
(config-if)#exit
```

lacp destination-mac

Use this command to set the address type to use for sending LACPDUs (Link Aggregation Control Protocol Data Units).

Note: The interface must be an aggregation port.

Use the `no` form of this command to set the address type to its default (multicast group address).

Command Syntax

```
lacp destination-mac  (customer-bridge-group-address | multicast-group-address |
  non-tmpr-group-address)
no lacp destination-mac
```

Parameters

`customer-bridge-group-address`

Customer bridge group address

`multicast-group-address`

Multicast group address (default)

`non-TPMR-group-address`

Non-Two-Port Media Access Control Relay (TPMR) group address

Default

By default, lacp destination-mac is multicast-group-address

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#config terminal
(config)#interface eth1
(config-if)#lacp destination-mac customer-bridge-group-address
```

lacp force-up

Use this command to make a port immediately begin forwarding packets and not wait for an LACPDU. After you execute this command, the member port is forcefully up even if LACP is not in sync (only if no other member in the aggregator is in sync).

If a force-up port stops receiving LACPDUs, the port ignores the time-out and remains in operation.

This command can be configured on one member interface of a port channel.

Note: This command can only be given after executing the channel-group mode command on an interface. Force-up mode is not supported for LACP passive mode.

Note: For MC-LAG, only configure a force-up port on either on the master node or the slave node to prevent traffic drops/loops.

Use the `no` form of this command to disable force-up mode.

Command Syntax:

```
lacp force-up
no lacp force-up
```

Parameters

None

Default

By default, LACP force-up mode is disabled.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Example

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#channel-group 1 mode active
(config-if)#lacp force-up
(config-if)#exit
```

lacp port-priority

Use this command to set the priority of a channel. Channels are selected for aggregation based on their priority with the higher priority (numerically lower) channels selected first.

Use the `no` parameter with this command to set the priority of port to the default value (32768).

Command Syntax

```
lacp port-priority <1-65535>
no lacp port-priority
```

Parameters

`<1-65535>`	Specify the LACP port priority.

Default

By default, lacp port priority is 32768

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#lacp port-priority 34
```

lacp system-priority

Use this command to set the LACP system priority. This priority determines the system responsible for resolving conflicts in the choice of aggregation groups.

Note: A lower numerical value has a higher priority.

Use the `no` parameter with this command to set the system priority to its default value (32768).

Command Syntax

```
lacp system-priority <1-65535>
no lacp system-priority
```

Parameters

`<1-65535>`	System priority.

Default

By default, system priority is 32768

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#lacp system-priority 6700
```

lacp timeout

Use this command to set either a short or long timeout value on a port. The timeout value is the number of seconds before invalidating a received LACP data unit (DU).

Command Syntax

```
lacp timeout (short|long)
```

Parameters

`short`	LACP short timeout. 3 seconds.
`long`	LACP long timeout. 90 seconds.

Note: **Short:** With this mode, BPDU will be sent at Fast_Periodic_Time of 1 second interval. It will timeout, before invalidating received LACPDU, after 3xFast_Periodic_Time(3seconds)

Note: **Long:** With this mode, BPDU will be sent at Slow_Periodic_Time of 30 seconds intervals. It will timeout, before invalidating received LACPDU, after 3xSlow_Periodic_Time(90seconds)

Default

By default, lacp timeout is long

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following sets the LACP short timeout on a port.

```
#configure terminal
(config)#interface eth0
(config-if)#lacp timeout short
```

port-channel load-balance

Use this command to configure LACP port-channel load-balancing and set port-selection criteria (PSC) for an interface.

Use the `no` option with this command to remove the load-balancing configuration and unset PSC.

Command Syntax

```
port-channel load-balance (dst-mac|src-mac|src-dst-mac|dst-ip|src-ip|src-dst-
  ip|dst-port|src-port|src-dst-port|rtag7)
no port-channel load-balance
```

Parameters

`dst-ip`	Destination IP address-based load balancing.
`dst-mac`	Destination MAC address-based load balancing.
`dst-port`	Destination TCP/UDP address-based load balancing.
`src-dst-ip`	Source and Destination IP address-based load balancing.
`src-dst-mac`	Source and Destination MAC address-based load balancing.
`src-dst-port`	Source and Destination TCP/UDP address-based load balancing.
`src-ip`	Source IP address-based load balancing.
`src-mac`	Source MAC address-based load balancing.
`src-port`	Source port address-based load balancing.
`rtag7`	Hashing based on packet type. IP - IP/Layer4 header, L2 - Layer2 header, TRILL - TRILL packet.

Default

By default, load balance is src-dst-port

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface po1
(config-if)#port-channel load-balance src-dst-mac
```

port-channel min-bandwidth - dynamic LAG min-bandwidth

Use this command to set the minimum number of aggregated bandwidth that need to be up in the LAG(PO) interface. When the minimum number of bandwidth are configured for a LAG(PO), if the active links bandwidth for that interface become less than the configured value, then the whole LAG(PO) is brought down. When the number of active links bandwidth become the same or more than the configured value, then the whole LAG is restored.

Use the no form of this command to remove the minimum number of aggregated bandwidth that need to be up in the LAG interface.

Note: The minimum number of aggregated bandwidth should be same across both ends of an aggregation interface. If not configured, then on one of the nodes the LAG port will be treated as up and on the other as down and traffic will be discarded.

Note: When a LAG port is moved to the down state because it does not have the minimum number of required bandwidth up and running, then the traffic on the remaining interfaces in the LAG will be counted as port-block discards.

Note: The port-channel min-links - dynamic LAG min-links feature and this feature are mutually exclusive. Both configurations cannot exist at the same time.

Command Syntax

```
port-channel min-bandwidth <1-1000>g
no port-channel min-bandwidth
```

Parameters

`<1-1000>g`	for 1 to 1000 gigabits/s

Default

By default, port channel min- bandwidth is disabled.

Command Mode

Interface mode

Applicability

This command was introduced from OcNOS version 1.3.8

Example

```
#configure terminal
(config)#interface po1
(config-if)#port-channel min-bandwidth 10g
```

port-channel min-links - dynamic LAG min-links

Use this command to set the minimum number of aggregated links that need to be up in the LAG(PO) interface. When the minimum number of links are configured for a LAG(PO), if the active links for that interface become less than the configured value, then the whole LAG(PO) is brought down. When the number of active links become the same or more than the configured value, then the whole LAG is restored.

Use the no form of this command to remove the minimum number of aggregated links that need to be up in the LAG interface.

Note: The minimum number of aggregated links should be same across both ends of an aggregation interface. If not configured, then on one of the nodes the LAG port will be treated as up and on the other as down and traffic will be discarded.

Note: When a LAG port is moved to the down state because it does not have the minimum number of required links up and running, then the traffic on the remaining interfaces in the LAG will be counted as port-block discards.

Note: The show debugging lacp feature and this feature are mutually exclusive. Both configurations cannot exist at the same time.

Command Syntax

```
port-channel min-links <2-32>
no port-channel min-links
```

Parameters

<2-32>	Minimum number of links

Default

By default, port channel min-link is disabled.

Command Mode

Interface mode

Applicability

This command was introduced from OcNOS version 1.3.8

Example

```
#configure terminal
(config)#interface po1
(config-if)#port-channel min-links 10
(config-if)#exit
```

port-channel min-bandwidth - static LAG min-bandwidth

Use this command to set the minimum number of aggregated bandwidth that need to be up in the LAG(SA) interface. When the minimum number of bandwidth are configured for a LAG(SA), if the active links bandwidth for that interface become less than the configured value, then the whole LAG(SA) is brought down. When the number of active links bandwidth become the same or more than the configured value, then the whole LAG is restored.

Use the no form of this command to remove the minimum number of aggregated bandwidth that need to be up in the LAG interface.

Note: The minimum number of aggregated bandwidth should be same across both ends of an aggregation interface. If not configured, then on one of the nodes the LAG port will be treated as up and on the other as down and traffic will be discarded.

Note: When a LAG port is moved to the down state because it does not have the minimum number of required bandwidth up and running, then the traffic on the remaining interfaces in the LAG will be counted as port-block discards.

Note: The port-channel min-links - static LAG min-links feature and this feature are mutually exclusive. Both configurations cannot exist at the same time.

Command Syntax

```
port-channel min-bandwidth <1-1000>g
no port-channel min-bandwidth
```

Parameters

`<1-1000>g`	for 1 to 1000 gigabits/s

Default

By default, port channel min- bandwidth is disabled.

Command Mode

Interface mode

Applicability

This command was introduced from OcNOS version 1.3.8

Example

```
#configure terminal
(config)#interface sa1
(config-if)#port-channel min-bandwidth 10g
```

port-channel min-links - static LAG min-links

Use this command to set the minimum number of aggregated links that need to be up in the LAG(SA) interface. When the minimum number of links are configured for a LAG(SA), if the active links for that interface become less than the configured value, then the whole LAG(SA) is brought down. When the number of active links become the same or more than the configured value, then the whole LAG is restored.

Use the no form of this command to remove the minimum number of aggregated links that need to be up in the LAG interface.

Note: The minimum number of aggregated links should be same across both ends of an aggregation interface. If not configured, then on one of the nodes the LAG port will be treated as up and on the other as down and traffic will be discarded.

Note: When a LAG port is moved to the down state because it does not have the minimum number of required links up and running, then the traffic on the remaining interfaces in the LAG will be counted as port-block discards.

Note: The port-channel min-bandwidth - static LAG min-bandwidth feature and this feature are mutually exclusive. Both configurations cannot exist at the same time.

Command Syntax

```
port-channel min-links <2-32>
no port-channel min-links
```

Parameters

<2-32>	Minimum number of links

Default

By default, port channel min-link is disabled.

Command Mode

Interface mode

Applicability

This command was introduced from OcNOS version 1.3.8

Example

```
#configure terminal
(config)#interface sa1
(config-if)#port-channel min-links 10
(config-if)#exit
```

show debugging lacp

Use this command to display the status of the debugging of the LACP system.

Command Syntax

```
show debugging lacp
```

Parameters

None

Command Mode

Exec and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show debugging lacp

LACP debugging status:
LACP timer debugging is on
```

show etherchannel

Use this command to display information about link aggregation groups.

Command Syntax

```
show etherchannel
show etherchannel <1-65535>
```

With MLAG:

```
show etherchannel (<1-16383>|) detail
show etherchannel (<1-16383>|) load-balance
show etherchannel (<1-16383>|) summary
```

Without MLAG:

```
show etherchannel (<1-65535>|) detail
show etherchannel (<1-65535>|) load-balance
show etherchannel (<1-65535>|) summary
```

Parameters

`<1-65535>`	Specify channel-group number.
`<1-16383>`	Specify channel-group number.
`detail`	Specify detailed etherchannel information.
`load-balance`	Specify load balancing.
`summary`	Specify Etherchannel summary information.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show etherchannel summary
% Aggregator po1 185
% Aggregator Type: Layer3
% Admin Key: 0001 - Oper Key 0001
%   Link: eth3 (5) sync: 0
-------------------------------------
% Aggregator po4 186
% Admin Key: 0004 - Oper Key 0004
%   Link: eth2 (4) sync: 0
-------------------------------------
% Aggregator po5 187
% Admin Key: 0005 - Oper Key 0005
%   Link: eth1 (3) sync: 0
```

```
#show etherchannel detail
% Aggregator po1 185
% Aggregator Type: Layer3
%  Mac address: 08:00:27:36:f5:7d
%  Admin Key: 0001 - Oper Key 0001
%  Actor LAG ID- 0x8000,08-00-27-fa-4b-0e,0x0001
%  Receive link count: 0 - Transmit link count: 0
%  Individual: 0 - Ready: 0
%  Partner LAG ID- 0x0000,00-00-00-00-00-00,0x0000
%   Link: eth3 (5) sync: 0
%  Collector max delay: 5
-------------------------------------------------
% Aggregator po4 186
%  Mac address: 08:00:27:76:0c:57
%  Admin Key: 0004 - Oper Key 0004
%  Actor LAG ID- 0x8000,08-00-27-fa-4b-0e,0x0004
%  Receive link count: 0 - Transmit link count: 0
%  Individual: 0 - Ready: 1
%  Partner LAG ID- 0x0000,00-00-00-00-00-00,0x0000
%   Link: eth2 (4) sync: 0
%  Collector max delay: 5
-------------------------------------------------
% Aggregator po5 187
%  Mac address: 08:00:27:2f:d5:ae
%  Admin Key: 0005 - Oper Key 0005
%  Actor LAG ID- 0x8000,08-00-27-fa-4b-0e,0x0005
%  Receive link count: 0 - Transmit link count: 0
%  Individual: 0 - Ready: 0
%  Partner LAG ID- 0x0000,00-00-00-00-00-00,0x0000
%   Link: eth1 (3) sync: 0
%  Collector max delay: 5
```

Table 5-11 explains the show command output fields.

Table 5-11: show etherchannel detail output

Field	Description
Aggregator	Link aggregators name and ID number.
Mac address	Unique MAC address for link identification.
Admin Key	LACP administrative key – automatically configured value on each port configured to use LACP.
Oper Key	LACP operator key on Partner – automatically configured value on each port configured to use LACP.
Actor LAG ID	LAG ID consisting of MAC address plus aggregator ID number for this Actor.
Receive link count	The number of link received from the peer LAG.
Transmit link count	The number of links contained transmitted to the peer LAG.
Individual	The individual physical network interfaces or ports contained in the LAG.
Ready	The number of links in the active state on this Actor.
Partner LAG ID	Partner LAG ID consisting of MAC address plus aggregator ID number.

Table 5-11: show etherchannel detail output (Continued)

Field	Description
Link	Interface and ID number of the link.
sync	MAC address synchronization enables a MC-LAG Partner to forward Layer 3 packets arriving on this interfaces with either its own MAC address or its Partner's.
Collector max delay	Maximum period of wait time between sending of two subsequent Ethernet frames on a link.

show lacp sys-id

Use this command to display the LACP system identifier and priority.

Command Syntax

```
show lacp sys-id
```

Parameters

`sys-id`	Display LACP system ID and priority

Command Mode

Exec and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show lacp sys-id
% System 8000,00-0e-0c-83-37-27
```

show lacp-counter

Use this command to display the packet traffic on all ports of all present LACP aggregators, or a given LACP aggregator.

Command Syntax

```
show lacp-counte
show lacp-counter <1-65535>
```

Parameters

<1-65535>	Channel-group number

Command Mode

Exec and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show lacp-counter 555

Port      LACPDUs          Marker          Pckt err
        Sent    Recv    Sent    Recv    Sent    Recv
```

show port etherchannel

Use this command to display details about a PO and its members' interfaces or to display details of a single member interface of a PO.

Command Syntax

```
show port etherchannel IFNAME
```

Parameters

IFNAME	Interface name

Command Mode

Exec and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show port etherchannel ce29/1
LAG ID                        : 0x8000,cc-37-ab-a0-89-ca,0x0002
Partner oper LAG ID           : 0x8000,a8-2b-b5-38-1e-48,0x0004
Aggregator ID                 : 100002
  LACP link info              : ce29/1 - 10001
  Periodic Transmission
  machine state               : Slow periodic
  Receive machine state       : Current
  Mux machine state           : Collecting/Distributing
  Actor Info :
  ===========
  Actor Port priority         : 0x8000 (32768)
  Admin key                   : 0x0002 (2) Oper key: 0x0002 (2)
  Physical admin key          : (2)
  Actor Oper state            : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
  Actor Admin state           : ACT:1 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0
  Partner Info:
  ============
  Partner oper port           : 10009
  Partner link info           : admin port 0
  Partner admin LAG ID        : 0x0000-00:00:00:00:0000
  Partner system priority     : admin:0x0000 - oper:0x8000
  Partner port priority       : admin:0x0000 - oper:0x8000
  Partner oper state          : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
  Partner admin state         : ACT:0 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0


#show port etherchannel po2
LAG ID                        : 0x8000,cc-37-ab-a0-89-ca,0x0002
Partner oper LAG ID           : 0x8000,a8-2b-b5-38-1e-48,0x0004
Aggregator ID                 : 100002
  LACP link info              : ce29/1 - 10001
  Periodic Transmission
  machine state               : Slow periodic
```

```
Receive machine state      : Current
Mux machine state          : Collecting/Distributing
Actor Info :
===========
Actor Port priority        : 0x8000 (32768)
Admin key                  : 0x0002 (2) Oper key: 0x0002 (2)
Physical admin key         : (2)
Actor Oper state           : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
Actor Admin state          : ACT:1 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0
Partner Info:
============
Partner oper port          : 10009
Partner link info          : admin port 0
Partner admin LAG ID       : 0x0000-00:00:00:00:0000
Partner system priority    : admin:0x0000 - oper:0x8000
Partner port priority      : admin:0x0000 - oper:0x8000
Partner oper state         : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
Partner admin state        : ACT:0 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0

LACP link info             : ce30/1 - 10005
Periodic Transmission
machine state              : Slow periodic
Receive machine state      : Current
Mux machine state          : Collecting/Distributing
Actor Info :
===========
Actor Port priority        : 0x8000 (32768)
Admin key                  : 0x0002 (2) Oper key: 0x0002 (2)
Physical admin key         : (2)
Actor Oper state           : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
Actor Admin state          : ACT:1 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0
Partner Info:
============
Partner oper port          : 10013
Partner link info          : admin port 0
Partner admin LAG ID       : 0x0000-00:00:00:00:0000
Partner system priority    : admin:0x0000 - oper:0x8000
Partner port priority      : admin:0x0000 - oper:0x8000
Partner oper state         : ACT:1 TIM:0 AGG:1 SYN:1 COL:1 DIS:1 DEF:0 EXP:0
Partner admin state        : ACT:0 TIM:0 AGG:1 SYN:0 COL:0 DIS:0 DEF:1 EXP:0
```

Note: Most of the output of this command is duplicated in the show etherchannel command (see also the 802.3ad specification). The output of the `show port etherchannel` command is primarily a list of state machine values. An explanation of the state machine bits follows. See Figure 5-1.

Table 5-12 explains the show command output fields.

Table 5-12: show port etherchannel detailed output

Entry	Description
Actor/Partner state	The Actor's and Partner's state variables, encoded as individual bits within a single octet.
ACT	LACP_Activity is encoded in bit 0. Active LACP is encoded as a 1; Passive LACP as a 0.

Table 5-12: show port etherchannel detailed output (Continued)

Entry	Description
TIM	LACP_Timeout is encoded in bit 1. Short Timeout is encoded as a 1; Long Timeout as a 0.
AGG	Aggregability is encoded in bit 2. Aggregatable is encoded as a 1; Individual is encoded as a 0.
SYN	Synchronization is encoded in bit 3. In_Sync is encoded as a 1; Out_Of_Sync is encoded as a 0.
COL	Collecting is encoded in bit 4. True is encoded as a 1; False is encoded as a 0.
DIS	Distributing is encoded in bit 5. True is encoded as a 1; False is encoded as a 0.
DEF	Defaulted is encoded in bit 6.
EXP	Defaulted is encoded in bit 7.

Bits 7 and 8 are reserved; these are ignored on receipt and transmitted as zero. However, the received value of these bits is recorded on receipt to accurately reflect the actor's view of the partner's state in outgoing PDUs.

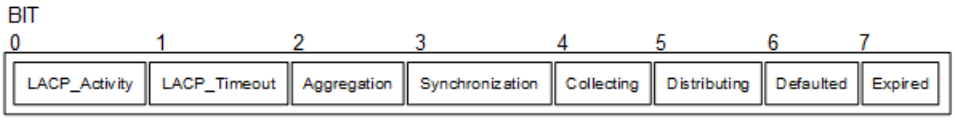


Figure 5-1: Diagram of state machine octet

show static-channel-group

Use this command to display the types of load-balancing port selection criteria (PSC) used on configured static aggregators.

Command Syntax

```
show static-channel-group  (<1-16383>|)
```

Parameters

<1-16383>	Specify channel-group number.

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

The following is an example of the output of this command:

```
#show  static-channel-group 1
% Static Aggregator: sa1
% Member:
   eth1
```

show static-channel load-balance

Use this command to display information about static channel groups.

Command Syntax

```
show static-channel (<1-16383>|) load-balance
```

Parameters

<1-16383>	Specify static-channel-group number.

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

The following is an example of the output of this command:

```
#show static-channel load-balance
% Static Aggregator: sa5
Source and Destination Mac address
-----------------------------------------
% Static Aggregator: sa3
Source and Destination Mac address
-----------------------------------------
% Static Aggregator: sa1
Source and Destination Mac address

#show static-channel 1 load-balance
% Static Aggregator: sa1
Source and Destination Mac address
```

snmp restart lacp

Use this command to restart SNMP in LACP.

Command Syntax

```
snmp restart lacp
```

Parameters

None

Default

By default, snmp restart lacp is disabled

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#snmp restart lacp
```

static-channel-group

Use this command to create a static link aggregation group or to add an interface to an existing link aggregation group.

Use the `no` form of this command to remove an interface from a static link aggregation group without removing the static link aggregation group itself.

Command Syntax

```
static-channel-group <1-16383>
no static-channel-group
```

Parameter

`<1-16383>`	Channel group number.

Default

By default, static channel group is disabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#static-channel-group 1
(config-if)#exit

#sh run in sa1
!
interface sa1
 switchport
 port-channel load-balance src-dst-mac
```

This is an example of `no static-channel-group`:

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#no static-channel-group
(config-if)#exit

#sh run in xe1
!
interface xe1
!
#sh run in sa1
!
interface sa1
 switchport
```

```
 port-channel load-balance src-dst-mac
!
```

CHAPTER 6 Multi-Chassis Link Aggregation Commands

This chapter describes the Multi-Chassis Link Aggregation commands.

Multi-Chassis Link Aggregation is also called MC-LAG, MLAG, or Distributed Resilient Network Interconnect (DRNI). In this document, it is called MC-LAG.

clear mcec statistics

Use this command to clear the statistics related to hello and information PDUs in the MCEC domain.

Command Syntax

```
clear mcec statistics
```

Parameters

None

Command Mode

Privileged exec mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#clear mcec statistics
```

debug mcec

Use this command to view debugging logs for MC-LAG.

Use the `no` form of this command to remove debugging logs for MC-LAG.

Command Syntax

```
debug mcec (timer|event|hello|info|cli|mac-sync|all)
no debug mcec (timer|event|hello|info|cli|mac-sync|all)
```

Parameters

`all`	ALL
`cli`	CLI
`event`	Event
`hello`	Hello
`info`	Info
`mac-sync`	Mac Sync
`timer`	Timer

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#debug mcec all
#no debug mcec all
```

domain-address

Use this command to configure domain address, which helps to identify the mcec domain.

Use the `no` form of this command to remove the domain address.

Command Syntax

```
domain-address <domain-id>
no domain-address
```

Parameters

```
domain-id  domain address in HHHH.HHHH.HHHH format
```

Command Mode

MCEC mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#domain-address 1111.2222.3333
```

domain hello timeout

Use this command to specify the domain hello-timeout value.

Command Syntax

```
domain-hello-timeout (long|short)
```

Parameters

`long`	Long Timeout
`short`	Short Timeout

Command Mode

MCEC mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#domain-hello-timeout long
```

domain priority

Use this command to specify the priority value associated with mcec domain.

Use the `no` form of this command to remove the priority value associated with mcec domain.

Command Syntax

```
domain-priority <1-65535>
no domain-priority
```

Parameters

`<1-65535>`	Priority Value

Command Mode

MCEC mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#domain-priority 2
```

domain-system-number

Use this command to configure domain system number, which uniquely identifies domain system in mcec domain.

Use the `no` form of this command to configure domain system number.

Command Syntax

```
domain-system-number <1-2>
no domain-system-number
```

Parameters

`<1-2>`	Domain System Number

Command Mode

MCEC mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#domain-system-number 2
```

intra-domain-link

Use this command to map an interface as intra domain link that connects the domain system with its neighbor in a mcec domain.

Use the no form of this command to unmap the interface configured as intra domain link that connects the domain system with its neighbor in a mcec domain.

Command Syntax

```
intra-domain-link <IFNAME>
no intra-domain-link
```

Parameters

IFNAME	Interface name

Command Mode

MCEC mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#intra-domain-link eth2
```

intra-domain-peer

Use this command to map an interface as intra domain peer that connects the domain system with its neighbor in a MCEC domain.

Use the no form of this command to unmap the interface configured as intra domain peer that connects the domain system with its neighbor in a MCEC domain.

Command Syntax

```
intra-domain-peer A.B.C.D source-address A.B.C.D (vrf VRF_NAME|)
no intra-domain-peer
```

Parameters

`Peer`	Address Peer/Target IPv4 address
`A.B.C.D`	IPv4 address.
`source-address`	Source IPv4 address
`A.B.C.D`	IPv4 address
`VRF_NAME`	VRF Interface name

Command Mode

MCEC mode

Applicability

This command was introduced in OcNOS-OTN version 4.2.

Example

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#intra-domain-peer 1.1.1.1 source-address 2.2.2.2 vrf
myvrf
```

mcec domain configuration

Use this command to enter MCEC Domain configuration mode to configure MCEC domain information.

Command Syntax

```
mcec domain configuration
```

Parameters

None

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#config terminal
(config)#mcec domain configuration
(config-mcec-domain)#
```

mlag

Use this command to map a port-channel to an MC-LAG instance.

Note: The MC-LAG port-channel (interface) must be created before mapping.

Note: All MC-LAG nodes must use the same MAC table size.

Use the `no` form of this command to un-map the port channel from the MC-LAG instance.

Command Syntax

```
mlag <1-255>
no mlag
```

Parameters

`<1-255>`	MC-LAG identifier

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3 and updated for static channel groups in OcNOS version 1.3.6.

Example

```
#config terminal
(config)#interface mlag1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode trunk
(config-if)#switchport mode trunk allowed vlan all
(config-if)#exit
(config)#interface sa1
(config-if)#switchport
 (config-if)#mlag 1
(config-if)#exit

#configure terminal
(config)#interface sa1
(config-if)#no mlag
```

mode

Use this command to set the MC-LAG mode.

Use the no form of this command to turn off this feature.

Command Syntax

```
mode (active-active | active-standby)
no mode (active-active | active-standby)
```

Parameters

`active-active`	The interface is the active interface that carries the traffic
`active-standby`	The interface is ready to transition to the active state should a failure occur in the other node

Default

`active-active`

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#
(config)#interface mlag1
(config-if)#mode active-active

(config)#
(config)#interface mlag1
(config-if)#mode active-standby
```

show mcec statistics

Use this command to display all the statistics related to hello and info pdu's in mcec domain.

Command Syntax

```
show mcec statistics
```

Parameters

None

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#sh mcec statistics
Unknown MCCPDU received on the system : 0

-----------------------------------
IDP xe49
-----------------------------------
Valid RX Hello PDUs : 109
Valid TX Hello PDUs : 201
Valid RX Info PDUs: 23
Valid TX Info PDUs : 28
Valid RX Mac Sync PDUs : 5
Valid TX Mac Sync PDUs : 4
Valid RX Dhcps Sync PDUs : 2
Valid TX Dhcps Sync PDUs : 1


MLAG 1
Valid RX Info PDUs : 5
Valid TX Info PDUs : 7
```

Table 6-14 Shows the output details.

Table 6-13: Show mcec statistics details

Entry	Description
RX Hello PDUs	Total number of received hello PDUs.
TX Hello PDUs	Total number of transmitted hello PDUs.
RX Info PDUs	Total number of received Info PDUs.
TX Info PDUs	Total number of transmitted Info PDUs.

Table 6-13: Show mcec statistics details

Entry	Description
RX Mac Sync PDUs	Total number of received Mac Sync PDUs.
TX Mac Sync PDUs	Total number of transmitted Mac Sync PDUs.
RX Dhcps Sync PDUs	Total number of received Dhcps Sync PDUs
TX Dhcps Sync PDUs	Total number of transmitted Dhcps Sync PDUs

show mlag detail

Use this command to display details about MC-LAG configuration and status.

Command Syntax

```
show mlag <1-255> detail
```

Parameters

<1-255>	MC-LAG group number

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3 and updated for static channel groups in OcNOS version 1.3.6.

Examples

```
#sh mlag 1 detail

MLAG-17
Mapped Aggregator : po1
Admin Key : 32769
Oper Key: 16385
Physical properties Digest : dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82

Neigh Admin Key: 16385
Neigh Physical Digest: dd 9c f 76 dd b6 5f 2f eb a1 d3 bb 8d 96 fc 82
Info RCV State : Current
Info Periodic Time State : Standby
Mlag Sync                : IN_SYNC
Mode                     : Active
```

Table 6-14 Shows the output details.

Table 6-14: Show mlag output details

Entry	Description
Mapped Aggregator	Map the output of the aggregator in the interface which is active transformation.
Admin Key	Administrative key: automatically configured value on each port configured to use MC-LAG.
Oper Key	MLAG operator key on partner: automatically configured value on each port configured to use MC-LAG.
Physical properties Digest	Physical properties of the digest.
Neigh Admin Key	Neigh administrative key: automatically configured value on each port configured to use MC-LAG.

Table 6-14: Show mlag output details

Entry	Description
Neigh Physical Digest	Neighbor physical properties of the digest.
Info RCV State	Details of the RCV.
Info Periodic Time State	A simple state space formulation of a general digital periodic time series.
Mlag Sync	MAC address synchronization: enables a MC-LAG partner to forward Layer 3 packets arriving on this interfaces with either its own MAC address or its partner's.

show mlag domain

Use this command to display MC-LAG configuration and status.

Command Syntax

```
show mlag domain (summary|details)
```

Parameters

summary	Summary
details	Details

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3 and updated for static channel groups in OcNOS version 1.3.6.

Examples

```
#show mlag domain summary

------------------------------------
Domain Configuration
------------------------------------

Domain System Number            : 1
Domain Address                  : 1111.2222.3333
Domain Priority                 : 32768
Intra Domain Interface          : sa5
Domain Adjacency                : UP

------------------------------------
MLAG Configuration
------------------------------------

MLAG-1
  Mapped Aggregator             : sa1
  Physical properties Digest    : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57
cc
  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active

MLAG-2
  Mapped Aggregator             : sa2
  Physical properties Digest    : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5
c8

  Total Bandwidth               : 40g
  Mlag Sync                     : IN_SYNC
  Mode                          : Active
```

```
#show mlag domain details
-----------------------------------
Domain Configuration
-----------------------------------
Domain System Number           : 1
Domain Address                 : 1111.2222.3333
Domain Priority                : 32768
Intra Domain Interface         : sa5

Hello RCV State                : Current
Hello Periodic Timer State     : Slow Periodic
Domain Sync                    : IN_SYNC
Neigh Domain Sync              : IN_SYNC
Domain Adjacency               : UP
-----------------------------------
MLAG Configuration
-----------------------------------
MLAG-1
  Mapped Aggregator            : sa1
  Admin Key                    : 16385
  Oper Key                     : 16385
  Physical properties Digest   : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57
cc

  Neigh Admin Key              : 32769
  Neigh Physical Digest        : d a6 26 2d fa 9a 5c 7b e6 15 79 c2 d5 9c 57
cc
  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Total Bandwidth              : 40g
  Mlag Sync                    : IN_SYNC

MLAG-2
  Mapped Aggregator            : sa2
  Admin Key                    : 16386
  Oper Key                     : 16386
  Physical properties Digest   : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5
c8
  Neigh Admin Key              : 32770
  Neigh Physical Digest        : ae 56 a1 c5 b9 dc 46 a4 5d 97 dc 79 9c 6f a5
c8

  Info RCV State               : Current
  Info Periodic Time State     : Standby
  Total Bandwidth              : 40g
  Mlag Sync                    : IN_SYNC
```

Table 6-15 Shows the output details.

Table 6-15: Show mlag summary details

Entry	Description
Domain System Number	Number to identify the node in domain.
Domain Address	Domain address for the MC-LAG domain.

Table 6-15: Show mlag summary details

Entry	Description
Domain Priority	Domain priority for the MC-LAG domain.
Intra Domain Interface	Intra domain interface between MC-LAG domains.
Domain Adjacency	Domain adjacency details and configuration.
Physical properties Digest	physical properties of the digest algorithm.
Total Bandwidth	Total bandwidth available on the interface.
Domain System Number	Number of the domain system.
Domain Address	Domain address for the MC-LAG domain.
Domain Priority	Domain priority for the MC-LAG domain.
Intra Domain Interface	Details of the intra domain in the interface.
Hello RCV State	State of the hello RCV in the interface.
Hello Periodic Timer State	State of the hello periodic timer in the interface.
Domain Sync	Detail of the domain configuration synchronization.
Mapped Aggregator	Map the output of the aggregator in the interface which is active transformation.
Admin Key	Administrative key:automatically configured value on each port configured to use MC-LAG.
Oper Key	MLAG operator key on partner:automatically configured value on each port configured to use MC-LAG.
Physical properties Digest	Physical properties of the digest.
Neigh Admin Key	Neighbot administrative key: automatically configured value on each port configured to use MC-LAG.
Neigh Physical Digest	Neighbor physical properties of the digest.
Info RCV State	Details of the RCV.
Info Periodic Time State	A simple state space formulation of a general digital periodic time series.
Mlag Sync	MAC address synchronization: enables a MC-LAG partner to forward Layer 3 packets arriving on this interfaces with either its own MAC address or its partner’s.

show spanning-tree mlag operational-config

Use this command to display the operational information for MC-LAG.

Command Syntax

```
show spanning-tree mlag operational-config
```

Parameters

None

Command Mode

Privilege exec mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#show spanning-tree mlag operational-config
 Operational Configuration
----------------------------------------
 Bridge Priority       : 32768
 Pathcost method       : Long

 Interface             : mlag1
Pathcost       : 1000
 Priority              : 0
```

show spanning-tree mlag sync-detail

Use this command to display the spanning-tree properties shared with the domain peer node.

Command Syntax

```
show spanning-tree mlag sync-detail
```

Parameters

None

Command Mode

Privilege exec mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#show spanning-tree mlag sync-detail
 Domain Digest Parameters
----------------------------------------
 Max Age              : 20
 BPDU Filter          : Disabled
 BPDU Guard           : Disabled
 Hello time           : 2
 Forward Delay        : 15
 Force Version        : 2
 Err-disable status   : Disabled
 Err-disable timeout  : 300
 MSTP Enabled         : Enabled
 MSTP Bridge Forward  : Disabled

 Interface Digest parameters
----------------------------
  Port Name              : mlag1
  Admin Root Guard       : Disabled
 Admin Edge port    : Disabled
 Portfast configuration : Disabled
  Restricted TCN         : Disabled
  Admin BPDU filter      : Default
  Admin BPDU guard       : Default
```

switchover type

Use this command to set the MC-LAG switchover type.

Use the `no` form of this command to turn off switchover.

Command Syntax

```
switchover type revertive <1-255>
switchover type non-revertive
no switchover type (revertive | non-revertive)
```

Parameters

`revertive`	If a failure happens that triggers a switchover, after failure recovery the initially-active node becomes active again
`<1-255>`	Switch back to the initially-active node this many seconds after failure recovery
`non-revertive`	Do not switch back to the initially-active node after failure recovery

Default

`revertive`	in 10 seconds

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#
(config)#interface mlag1
(config-if)#switchover type revertive 20

(config)#
(config)#interface mlag1
(config-if)#switchover type non-revertive
```

CHAPTER 7 VLAN and Private VLAN Commands

This chapter has the commands used to manage VLANs and private VLANs.

show dtag vlan

Use this command to display information about VLAN double tagging.

Command Syntax

```
show dtag vlan DTAG_VLAN_ID
```

Parameters

DTAG-VLAN-IDs	Outer-VLAN identifier and inner-VLAN identifier in the format 100.200, where 100 is the outer tag and 200 is the inner tag

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show dtag vlan 2000.3001
```

Table 7-16 explains the output.

Table 7-16: show dtag vlan output

Field	Description
Bridge	Bridge number
VLAN ID	VLAN identifier
Name	Double tag-VLAN identifers
State	VLAN state: ACTIVE, SUSPEND, or INVALID
H/W Status	Hardware status: UP or DOWN
Member ports	Interfaces that are part of the VLAN and whether untagged (u) or tagged (t)

show vlan access-map

Use this command to display information for VLAN access maps.

Command Syntax

```
show vlan access-map
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show vlan access-map
Vlan access-map myMap 10
       match ip: myMap
       action: drop
```

show vlan

Use this command to display information about static, dynamic or all VLANs.

Command Syntax

```
show vlan (all|static|dynamic|auto) bridge <1-32>
```

Parameters

`<1-32>`	Displays the bridge group ID.
`all`	Displays all VLANs (static and dynamic).
`static`	Displays static VLANs.
`dynamic`	Displays dynamic VLANs.
`auto`	Displays auto configured VLANs.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#sh vlan all bridge 1
Bridge  VLAN ID     Name          State   H/W Status      Member ports
                                                        (u)-Untagged, (t)-Tagged
======= ======= ================ ======= ========== ============================
1       1       default          ACTIVE  Up         xe2(u) xe10(u)
1       2       vlan2            ACTIVE  Up         xe10(t)
1       10      VLAN0010         ACTIVE  Up         xe2(t) xe10(t)
1       20      VLAN0020         ACTIVE  Up         xe2(t) xe10(t)
1       30      VLAN0030         ACTIVE  Up         xe10(t)
1       40      VLAN0040         ACTIVE  Up         xe10(t)
1       50      VLAN0050         ACTIVE  Up         xe10(t)
1       60      VLAN0060         ACTIVE  Up         xe10(t)
#
```

Table 7-17 Explains the show command output fields.

Table 7-17: show vlan output fields

Table 7-18:

Field	Description
Bridge	Number of bridge in the interface.
VLAN ID	VLAN identifier of the VLAN listed.
Name	Name of the VLAN.
State	Indicates whether the physical link is operational and can pass packets.

Table 7-18:

Field	Description
H/W Status	Indicates that the hardware is operational.
Member ports	The tagged interfaces to which a VLAN is associated.

show vlan brief

Use this command to display brief VLAN information for all bridges.

Command Syntax

```
show vlan (brief | <2-4094>)
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following is a sample output from this command when using the `all` parameter.

```
#show vlan brief

Bridge          VLAN ID  Name            State   Member ports
                                                 (u)-Untagged, (t)-Tagged
=============== ======= ================ ======= ==============================
1               1       default          ACTIVE  eth2(u)


0               1       default          ACTIVE
0               2       new              ACTIVE
```

Table 7-19 Explains the show command output fields.

Table 7-19: show vlan brief output fields

Table 7-20:

Field	Description
Bridge	Number of bridge in the interface.
VLAN ID	VLAN identifier of the VLAN listed.
Name	Name of the VLAN.
State	Indicates whether the physical link is operational and can pass packets.
H/W Status	Indicates that the hardware is operational.
Member ports	The tagged interfaces to which a VLAN is associated.

show vlan classifier

Use this command to display information on configured VLAN classifier groups, interfaces configured for a VLAN group or all the groups, or all configured VLAN classifier rules.

If either a group ID or rule ID is not specified, all configured VLAN classifier rules are shown. If either a group ID or rule ID is specified, a specific configured VLAN classifier rule is shown.

Command Syntax

```
show vlan classifier group interface IFNAME
show vlan classifier group (<1-16>|)
show vlan classifier rule(<1-256>|)
```

Parameters

`group`	Displays group activated information.
`<1-16>`	Displays the group ID
`interface`	Displays interface information.
`interface`	Displays interface group information.
`group`	Displays group activated information.
`<1-16>`	Displays the group ID.
`rule`	Displays VLAN classifier rule ID.
`<1-256>`	Displays rule ID information.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

This example displays groups for VLAN classifier groups:

```
#show vlan classifier group 1
vlan classifier group 1 add rule 1
```

This example displays interfaces for all VLAN classifier groups:

```
#show vlan classifier interface group
vlan classifier group 1 interface fe2
vlan classifier group 1 interface fe3
vlan classifier group 2 interface fe5
vlan classifier group 3 interface fe7
```

This example displays interfaces for VLAN classifier group 1:

```
#show vlan classifier interface group 1
vlan classifier group 1 interface fe2
vlan classifier group 1 interface fe3
```

This example displays interfaces for VLAN classifier rule 1:

```
#show vlan classifier rule 1
vlan classifier rule 1 mac 222.2222.2222 vlan 2
```

show vlan-reservation

Use this command to display reserved vlans that are configured via vlan-reservation configuration on the switch.

Command Syntax

```
show vlan-reservation
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 5.1.

Example

```
OcNOS#show vlan-reservation
VLAN ID         Status
=======         ======
500             free
501             free
502             free
503             free
504             free
505             free
506             free
507             free
508             free
509             free
510             free
OcNOS#
```

If user enables port breakout on any of the interface

```
OcNOS(config)#interface xe54/1
OcNOS(config-if)#port breakout enable
OcNOS(config-if)#commit
```

Each subsidiary ports 54/2, 54/3, 54/4 will get vlan-id from the vlan-reservation pool and the status of vlan-id changes to "allocated".

```
OcNOS#show vlan-reservation
VLAN ID         Status
=======         ======
500             allocated
501             allocated
502             allocated
503             free
504             free
505             free
```

```
506             free
507             free
508             free
509             free
510             free
OcNOS#
```

Note: From OcNOS version 5.1, it is mandatory to configure vlan-reservation prior to port breakout configuration.

switchport access

Use this command to change the default VLAN on the current interface.

Note: IP Infusion Inc. does not recommend using VLAN identifier 1 because of interoperability issues with other vendors' equipment.

Use the `no` parameter to remove an existing VLAN.

Command Syntax

```
switchport access vlan <2-4094>
no switchport access vlan
```

Parameter

`<2-4094>`	Specify the VLAN identifier.

Default

The switchport access vlan default value is 3968.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

This example shows the steps of a typical VLAN session, creating and destroying a VLAN.

```
#configure terminal
(config)#interface eth0
(config-if)#switchport access vlan 3

(config)#interface eth0
(config-if)#no switchport access vlan
```

switchport hybrid

Use this command to set the switching characteristics of the interface to hybrid. Both tagged and untagged frames will be classified over hybrid interfaces.

For a VLAN range, specify two VLAN identifiers: the lowest and then the highest separated by a hyphen. For a VLAN list, specify the VLAN identifiers separated by commas. Do not enter spaces between the hyphens or commas.

Use the `no` parameter to turn off allowed hybrid switching.

Command Syntax

```
switchport hybrid allowed vlan all
switchport hybrid vlan <2-4094>
switchport hybrid allowed vlan none
switchport hybrid allowed vlan except VLAN_ID
switchport hybrid allowed vlan remove VLAN_ID
switchport hybrid allowed vlan add VLAN_ID egress-tagged (enable|disable)
no switchport hybrid
no switchport hybrid vlan
```

Parameters

`all`	Allow all VLANs to transmit and receive through the interface.
`none`	Allow no VLANs to transmit and receive through the interface.
`except`	Allow all VLANs except these VLANs to transmit and receive through the interface.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.
`remove`	Remove these VLANs from the member set.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.
`add`	Add these VLANs to the member set.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.
`egress-tagged`	Whether to tag outgoing frames.
`enable`	Enable egress tagging for outgoing frames.
`disable`	Disable egress tagging for outgoing frames.

Default

By default, switchport hybrid is enabled.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

The following shows adding a single VLAN to the member set.

```
(config-if)#switchport hybrid allowed vlan add eg
switchport hybrid allowed vlan add 2 egress-tagged enable
```

The following shows adding a range of VLANs to the member set.

```
(config-if)#switchport hybrid allowed vlan add eg
switchport hybrid allowed vlan add 2-4 egress-tagged enable
```

switchport mode

Use this command to set the switching characteristics of the Layer 2 interface.

Command Syntax

```
switchport mode (access|hybrid|trunk|provider-network|customer-edge
|customer-network|private-vlan)
```

Parameters

`access`	Access.
`hybrid`	Hybrid.
`trunk`	Trunk.
`provider-network`	Provider network.
`customer-network`	Customer network.

Default

By default, switchport mode hybrid is enabled.

Configuring an interface to operate in trunk mode using the CLI command `switchport mode trunk` will automatically permit VLAN ID 1 on the trunk ports by default.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode access
```

switchport mode access ingress-filter

Use this command to set the switching characteristics of the interface to access mode, and classify untagged frames only. Received frames are classified based on the VLAN characteristics, then accepted or discarded based on the specified filtering criteria.

Command Syntax

```
switchport mode access ingress-filter (enable|disable)
```

Parameters

`ingress-filter`	Set the ingress filtering for the received frames.
`enable`	Set the ingress filtering for received frames. Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded. This is the default value.
`disable`	Turn off ingress filtering to accept frames that do not meet the classification criteria.

Default

Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode access ingress-filter enable
```

switchport mode hybrid acceptable-frame-type

Use this command to set the interface acceptable frame types. This processing occurs after VLAN classification.

Use `no` form of this command to unconfigure the interface acceptable frames.

Command Syntax

```
switchport mode hybrid acceptable-frame-type (all|vlan-tagged)
no switchport hybrid
```

Parameters

`all`	Set all frames can be received
`vlan-tagged`	Accept only classified frames that belong to the port's member set.

Default

Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/ trunk) are discarded.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode hybrid acceptable-frame-type vlan-tagged
```

switchport mode hybrid ingress-filter

Use this command to set the switching characteristics of the interface as hybrid, and classify both tagged and untagged frames. Received frames are classified based on the VLAN characteristics, then accepted or discarded based on the specified filtering criteria.

Command Syntax

```
switchport mode hybrid ingress-filter (enable|disable)
```

Parameters

`enable`	Set the ingress filtering for received frames. Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded. This is the default value.
`disable`	Turn off ingress filtering to accept frames that do not meet the classification criteria.

Default

Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode hybrid ingress-filter enable
```

switchport mode trunk ingress-filter

Use this command to set the switching characteristics of the interface as trunk, and specify only tagged frames. Received frames are classified based on the VLAN characteristics, then accepted or discarded based on the specified filtering criteria.

Command Syntax

```
switchport mode trunk ingress-filter (enable|disable)
```

Parameters

`ingress-filter`	Set the ingress filtering for the received frames.
`enable`	Set the ingress filtering for received frames. Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded. This is the default value.
`disable`	Turn off ingress filtering to accept frames that do not meet the classification criteria.

Default

Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode trunk ingress-filter enable
```

switchport trunk allowed

Use this command to set the switching characteristics of the interface to trunk.

For a VLAN range, specify two VLAN identifiers: the lowest and then the highest separated by a hyphen. For a VLAN list, specify the VLAN identifiers separated by commas. Do not enter spaces between the hyphens or commas.

Use the `no` parameter to remove all VLAN identifiers configured on this port.

Command Syntax

```
switchport trunk allowed vlan all
switchport trunk allowed vlan none
switchport trunk allowed vlan add VLAN_ID
switchport trunk allowed vlan except VLAN_ID
switchport trunk allowed vlan remove VLAN_ID
no switchport trunk
```

Parameters

`all`	Allow all VLANs to transmit and receive through the interface.
`none`	Allow no VLANs to transmit and receive through the interface.
`add`	Add these VLANs to the member set.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.
`except`	All VLANs except these VLANs are part of the member set.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.
`remove`	Remove these VLANs from the member set.
`VLAN_ID`	VLAN identifier(s) <2-4094>. You can specify a single VLAN, a VLAN range, or a VLAN list.

Default

Received frames that cannot be classified in the previous step based on the acceptable frame type parameter (access/trunk) are discarded.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

The following shows adding a single VLAN to the port's member set.

```
(config)#interface eth0
(config-if)#switchport trunk allowed vlan add 2
```

The following shows adding a range of VLANs to the port's member set.

```
(config)#interface eth0
(config-if)#switchport trunk allowed vlan add 2-4
```

switchport trunk allowed vlan dtag

Use this command to maintain a mapping between the double-tagged logical interfaces with the physical interfaces for the purpose of enabling VLAN-translation on the port alone.

An example of when to use this command is in a GPON application, where an S-tag uniquely identifies an OLT channel partition and a C-tag uniquely identifies a subscriber/service on that channel partition.

Command Syntax

```
switchport trunk allowed vlan add dtag DTAG-VLAN-IDs
switchport trunk allowed vlan remove dtag DTAG-VLAN-IDs
```

Parameters

`add`	Add a mapping
`remove`	Remove a mapping
`DTAG-VLAN-IDs`	Outer-VLAN identifier and inner-VLAN identifier in the format 100.200, where 100 is the outer tag and 200 is the inner tag

Default

None

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#int mlag1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode trunk
(config-if)#switchport trunk allowed vlan add 100,2000
(config-if)#switchport trunk allowed vlan add dtag 2000.3001
```

switchport trunk native

Use this command to configure native VLANs for this port. The native VLAN is used for classifying the incoming untagged packets.

Use the `no` parameter to revert the native VLAN to the default VLAN identifier 1.

Command Syntax

```
switchport trunk native vlan VLAN_ID
no switchport trunk native vlan
```

Parameter

`VLAN_ID`	VLAN identifier(s) <1-4094>. You can specify a single VLAN, or a VLAN list. For a VLAN list, specify the VLAN identifiers separated by commas. Do not enter spaces in between the hyphens or commas.

Default

The default is that ingress filtering is off and all frame types are classified and accepted.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#switchport trunk native vlan 2

(config)#interface eth0
(config-if)#no switchport trunk native vlan
```

vlan classifier activate

Use this command to activate the VLAN classifier.

Use no form of this command to deactivate the VLAN classifier.

Command Syntax

```
vlan classifier activate <1-16> vlan <2-4096>
no vlan classifier activate <1-16>
```

Parameters

<1-16>	Indicates the VLAN classifier activate identifier.
<2-4094>	VLAN identifier of the primary VLAN.

Default

By default, vlan classifier activate value is 1

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth2
(config-if)#vlan classifier activate 1 vlan 2

(config-if)#no vlan classifier activate 1
```

vlan classifier group

Use this command to create a subnet-based VLAN classifier group. A group indicates a VLAN classifier group ID.

Command Syntax

```
vlan classifier group <1-16> (add | delete) rule <1-256>
no vlan classifier group <1-16>
```

Parameters

`add`	Adds a rule to a group.
`delete`	Deletes a rule from a group.
`rule`	Indicates the VLAN classifier rule identifier `<1-256>`.

Default

By default, vlan classifier group value is 1

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#vlan classifier group 1 delete rule 1
(config)#no vlan classifier group 2
```

vlan classifier rule ipv4

Use this command to create a subnet-based VLAN classifier rule and map it to a specific VLAN. If the source IP address matches the IP subnet specified in the VLAN classifier rule, received packets are mapped to the designated VLAN.

Command Syntax

```
vlan classifier rule <1-256> ipv4 A.B.C.D/M
no vlan classifier rule <1-256>
```

Parameters

`A.B.C.D/M`	Indicates the IPv4 address classification. Enter the address in A.B.C.D/M format.

Default

By default, vlan classifier rule is VLAN1

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#vlan classifier rule 2 ipv4 20.20.20.2/24
(config)#no vlan classifier rule 2
```

vlan classifier rule mac

Use this command to create a subnet-based VLAN classifier rule and map it to a specific VLAN.

If the source IP address matches the IP subnet specified in the VLAN classifier rule, received packets are mapped to the designated VLAN.

Command Syntax

```
vlan classifier rule <1-256> mac WORD
no vlan classifier rule <1-256>
```

Parameters

WORD	Indicate the Mac address classification. Enter the address in HHHH.HHHH.HHHH format.

Default

By default, vlan classifier rule value is VLAN1

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#vlan classifier rule 2 mac fe80::22e::b5ff:fee8:6/64
(config)#no vlan classifier rule 2
```

vlan classifier rule proto

Use this command to create a subnet-based VLAN classifier rule for a protocol and map it to a specific VLAN. If the source IP address matches the IP subnet specified in the VLAN classifier rule, received packets are mapped to the designated VLAN.

Command Syntax

```
vlan classifier rule <1-256> proto
  (ETHERTYPE|ip|x25|arp|g8bpqx25|ieeepup|ieeeaddrtrans|dec|decdnadumpload|decdnare
  moteconsole|decdnarouting|declat|decdiagnostics|rarp|atalkddp|atalkaarp|ipx|ipv6
  |atmmulti|pppdiscovery|pppsession|atmtransport)
no vlan classifier rule <1-256>
```

Parameters

ETHERTYPE	Ethernet type
ip	IP address
x25	CCITT X.25
arp	Address Resolution Protocol
g8bpqx25	G8BPQ AX.25
ieeepup	Xerox IEEE802.3 PUP
ieeeaddrtrans	Xerox IEEE802.3 PUP Address Translation
dec	DEC Assigned
decdnadumpload	DEC DNA Dump/Load
decdnaremoteconsole	DEC DNA Remote Console
decdnarouting	DEC DNA Routing
declat	DEC LAT
decdiagnostics	EC Diagnostics
rarp	Reverse Address Resolution
atalkddp	Appletalk DDP
atalkaarp	Appletalk AARP
ipx	IPX address
ipv6	IPv6 address
atmmulti	MultiProtocol Over ATM
pppdiscovery	PPPoE discovery
pppsession	PPPoE session
atmtransport	Frame-based ATM Transport
deccustom	DEC Customer use
decsyscomm	DEC Systems Comms Arch
xeroxaddrtrans	Xerox PUP Address Translation

Default

By default, VLAN classifier rule value is VLAN1

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#vlan classifier rule 2 proto ip
(config)#no vlan classifier rule 2
```

vlan database

Use this command to enter the VLAN configuration mode to add, delete, or modify values associated with a single VLAN.

Command Syntax

```
vlan database
```

Parameters

None

Default

No default value is specified

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

In the following example, note the change to VLAN configuration mode from Configure mode:

```
#configure terminal
(config)#vlan database
(config-vlan)#
```

vlan dtag

Use this command to enable or disable double tagging packets with an outer-VLAN identifier and an inner-VLAN identifier.

An example of when to use this command is in a GPON application, where an S-tag uniquely identifies an OLT channel partition and a C-tag uniquely identifies a subscriber/service on that channel partition.

Use the `no` form of this command to not double tag packets.

Command Syntax

```
vlan dtag DTAG-VLAN-IDs bridge <1-32> state (enable|disable) subscriber
no vlan dtag DTAG-VLAN-IDs bridge <1-32>
```

Parameters

`DTAG-VLAN-IDs`	Outer-VLAN identifier and inner-VLAN identifier in the format 100.200, where 100 is the outer tag and 200 is the inner tag
`<1-32>`	Bridge number
`enable`	Enable double tagging
`disable`	Suspend double tagging

Default

No default value is specified

Command Mode

VLAN database mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
(config)#vlan database
(config-vlan)#vlan dtag 2000.3001 bridge 1 state enable subscriber
```

vlan-reservation

Use this command to create/delete vlan reservation pool on the switch.

Command Syntax

```
vlan-reservation VLAN_RANGE
no vlan-reservation VLAN_RANGE
```

Parameters

VLAN_RANGE	VLAN ID 2-4094 or range(s): 2-5,10 or 2-5,7-19

Default

No default value is specified

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 5.1.

Example

In the following example, note the change to VLAN configuration mode from Configure mode:

```
#configure terminal
(config)#vlan database
(config-vlan)#
```

vlan state

This command enables or disables the state of a particular VLAN on the bridge.

Command Syntax

```
vlan <2-4094> bridge <1-32> (state (enable|disable)|)
```

Parameters

`<1-32>`	Specify bridge group ID
`state`	Indicates the operational state of the VLAN
`enable`	Sets VLAN into a enable state.
`disable`	Sets VLAN into a disable state.
`name`	The VLAN name
`WORD`	The name of the VLAN

Default

By default, vlan bridge state is disabled.

Command Mode

VLAN Configuration mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#vlan database
(config-vlan)#vlan 45 bridge 1 state enable
```

vlan VLAN_RANGE bridge

.This command allows you to create a single/range of VLAN’s on the VLAN aware bridges.

Use the no form of this command to delete the VLAN.

Command Syntax

```
vlan VLAN_RANGE bridge <1-32>
vlan VLAN_RANGE bridge <1-32> (name WORD|) state (enable | disable)
no vlan VLAN_RANGE bridge <1-32>
```

Parameters

VLAN_RANGE	The vlan-id or range of vlan-id's separated by ','&'-'
bridge	Specify the bridge group ID in the range <1-32>.
state	Indicates the operational state of the VLAN.
enable	Sets VLAN into an enable state.
disable	Sets VLAN into a disable state.

Default

By default, vlan bridge state is disabled

Command Mode

Configuration Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#vlan 3-40,56 bridge 4
(config)#no vlan 2-5 bridge 2
```

CHAPTER 8 802.1x Commands

This chapter provides a description, syntax, and examples of the 802.1X commands. It includes the following commands:

auth-mac auth-fail-action

Use this command to specify the required action after authentication fails for any source MAC (Media Access Control). If `drop-traffic` is specified, data destined to that MAC is dropped. The MAC will be added to the forwarding database in Discarded mode.

If `restrict-vlan` is specified, the unauthorized MAC is added to a restricted VLAN. The MAC will be added to the forwarding database in Forwarding mode.

Command Syntax

```
auth-mac auth-fail-action (restrict-vlan <2-4094>|drop-traffic)
```

Parameters

`drop-traffic`	Drops traffic destined to unauthorized source.
`restrict-vlan`	Adds unauthorized MAC address to restricted VLAN.
`<2-4094>`	Identity of the VLAN in the range of <2-4094>.

Default

drop-traffic

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#auth-mac auth-fail-action restrict-vlan 12
```

auth-mac disable

Use this command to disable MAC authentication on an interface. See the auth-mac enable command to enable MAC authentication on a interface.

Command Syntax

```
auth-mac disable
auth-mac disable mode (filter|shutdown)
```

Parameters

mode	Use this parameter to disable the MAC authentication mode on an interface.
filter	Filter the frames for the MAC when in an unauthorized state.
shutdown	Shut down the interface when the MAC is unauthenticated.

Default

No default value is specified.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#auth-mac disable

#configure terminal
(config)#interface eth0
(config-if)#auth-mac disable mode filter

(config)#interface eth0
(config-if)#auth-mac disable mode shutdown
```

auth-mac dynamic-vlan-creation

Use this command to enable or disable dynamic VLAN creation after successful MAC authentication.

Command Syntax

```
auth-mac dynamic-vlan-creation (enable|disable)
```

Parameters

`disable`	Disables dynamic VLAN creation: after a successful authentication, the MAC will be added to the forwarding database with the default VLAN
`enable`	Enables dynamic VLAN creation: after a successful authentication, the MAC under authentication will be added to the VLAN identifier attribute in the radius server configuration file

Default

Disabled

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#auth-mac dynamic-vlan-creation disable

#configure terminal
(config)#interface eth0
(config-if)#auth-mac dynamic-vlan-creation enable
```

auth-mac enable

Use this command to enable MAC authentication on an interface. See the auth-mac disable command to disable MAC authentication on an interface.

Command Syntax

```
auth-mac enable
auth-mac enable mode (filter|shutdown)
```

Parameters

mode	Use this parameter to enable the MAC authentication mode on an interface.
filter	Filter the frames for the MAC when in an unauthorized state.
shutdown	Shut down the interface when the MAC is unauthenticated.

Default

By default, MAC authentication is globally disabled on the device.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#auth-mac enable

#configure terminal
(config)#interface eth0
(config-if)#auth-mac enable mode filter

(config)#interface eth0
(config-if)#auth-mac enable mode shutdown
```

auth-mac mac-aging

Use this command to either enable or disable MAC aging. When enabled, a MAC entry is added to the forwarding database, with aging time equal to the bridge aging time. Otherwise, the MAC entry will not be aged out. If MAC aging is disabled, the MAC entry will not be aged out.

Command Syntax

```
auth-mac mac-aging (enable|disable)
```

Parameters

`disable`	Disables MAC aging.
`enable`	Enables MAC aging.

Default

Disabled.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#auth-mac mac-aging disable

#configure terminal
(config)#interface eth0
(config-if)#auth-mac mac-aging enable
```

auth-mac system-auth-ctrl

Use this command to enable MAC authentication globally. If MAC authentication is not enabled, other MAC authentication related commands throw an error when issued.

Use the `no` parameter with this command to disable MAC authentication globally.

Command Syntax

```
auth-mac system-auth-ctrl
no auth-mac system-auth-ctrl
```

Parameters

None

Default

Authentication system messages are not displayed.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#auth-mac system-auth-ctrl

(config)#no auth-mac system-auth-ctrl
```

debug dot1x

Use this command to turn on or turn off 802.1x debugging at various levels.

Use the `no` parameter with this command or the `undebug` command to turn off debugging.

Command Syntax

```
debug dot1x (all|)
debug dot1x event
debug dot1x nsm
debug dot1x packet
debug dot1x timer
no debug dot1x (all|)
no debug dot1x event
no debug dot1x nsm
no debug dot1x packet
no debug dot1x timer
undebug dot1x (all|)
undebug dot1x event
undebug dot1x packet
undebug dot1x nsm
undebug dot1x timer
```

Parameters

`all`	Sets debugging for all 802.1x levels.
`event`	Sets debugging for 802.1x events.
`nsm`	Sets debugging for 802.1x NSM information.
`packet`	Sets debugging for 802.1x packets.
`timer`	Sets debugging for 802.1x timer.

Default

No default value is specified.

Command Mode

Exec, Privileged Exec, and Configure modes

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#debug dot1x all
(config)#debug dot1x event
```

dot1x initialize

Use this command to unauthorize a port, and attempt reauthentication on the specified interface.

Command Syntax

```
dot1x initialize interface IFNAME
```

Parameters

`interface`	Interface name.

Default

No default value is specified.

Command Mode

Privileged Exec

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#dot1x initialize interface eth0
```

dot1x keytxenabled

Use this command to enable or disable key transmission over an Extensible Authentication Protocol (EAP) packet between the authenticator and supplicant.

Command Syntax

```
dot1x keytxenabled (enable|disable)
```

Parameters

`disable`	Disables the key transmission.
`enable`	Enables the key transmission.

Default

The dot1x keytxenabled default is disabled.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if) #dot1x keytxenabled disable

#configure terminal
(config)#interface eth0
(config-if) #dot1x keytxenabled enable
```

dot1x port-control

Use this command to force a port state.

Use the `no` parameter with this command to remove a port from the 802.1x management.

Command Syntax

```
dot1x port-control dir (in|both)
dot1x port-control (force-unauthorized|force-authorized|auto)
no dot1x port-control
```

Parameters

`auto`	Specify to enable authentication on port.
`dir`	Specify the packet control direction.
`both`	Discard receive and transmit packets from the supplicant
`in`	Discard receive packets from the supplicant
`force-authorized`	Specify to force a port to always be in an authorized state.
`force-unauthorized`	Specify to force a port to always be in an unauthorized state.

Default

The dot1x port-control default is active.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x port-control auto

(config)#interface eth0
(config-if)#no dot1x port-control
```

dot1x protocol-version

Use this command to set the protocol version of dot1x to 1 or 2. The protocol version must be synchronized with the Xsupplicant being used in that interface.

Use the `no` parameter with this command to set the protocol version to the default value (2).

Command Syntax

```
dot1x protocol-version <1-2>
no dot1x protocol-version
```

Parameters

`<1-2>`	Indicates the EAP Over LAN (EAPOL) version.

Default

The default dot1x protocol version is 2.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x protocol-version 2

(config)#interface eth0
(config-if)#no dot1x protocol-version
```

dot1x quiet-period

Use this command to set the quiet-period time interval.

When a switch cannot authenticate a client, the switch remains idle for a quiet-period interval of time, then tries again. By administratively changing the quiet-period interval, by entering a lower number than the default, a faster response time can be provided.

Use the `no` parameter with this command to set the configured quiet period to the default (60 seconds).

Command Syntax

```
dot1x quiet-period <1-65535>
no dot1x quiet-period
```

Parameter

`<1-65535>`	Seconds between the retrial of authentication.

Default

The default dot1x protocol version is 2.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x quiet-period 200
```

dot1x reauthMax

Use this command to set the maximum reauthentication value, which sets the maximum number of reauthentication attempts after which the port will be unauthorized.

Use the `no` parameter with this command to set the reauthentication maximum to the default value (2).

Command Syntax

```
dot1x reauthMax <1-10>
no dot1x reauthMax
```

Parameter

`<1-10>`	Indicates the maximum number of reauthentication attempts after which the port will be unauthorized.

Default

The default is 2.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

The following sets the maximum reauthentication value to 5.

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x reauthMax 5
```

The following sets the reauthentication maximum to the default value.

```
#configure terminal
(config)#interface eth0
(config-if)#no dot1x reauthMax
```

dot1x reauthentication

Use this command to enable reauthentication on a port.

Use the `no` parameter to disable reauthentication on a port.

Command Syntax

```
dot1x reauthentication
no dot1x reauthentication
```

Parameters

None

Default

The dot1x reauthentication default is disabled.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x reauthentication
```

dot1x system-auth-ctrl

Use this command to enable globally authentication.

Use the `no` parameter to disable globally authentication.

Command Syntax

```
dot1x system-auth-ctrl
no dot1x system-auth-ctrl
```

Parameters

None

Default

Authentication is off by default.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#dot1x system-auth-ctrl
```

dot1x timeout re-authperiod

Use this command to set the interval between reauthorization attempts.

Use the `no` parameter to disable the interval between reauthorization attempts.

Command Syntax

```
dot1x timeout re-authperiod <1-4294967295>
no dot1x timeout re-authperiod
```

Parameter

`<1-4294967295>` Specify the seconds between reauthorization attempts.

Default

Default time is 3600 seconds

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x timeout re-authperiod 25
```

dot1x timeout server-timeout

Use this command to set the authentication sever response timeout.

Use the `no` parameter to disable the authentication sever response timeout.

Command Syntax

```
dot1x timeout server-timeout <1-65535>
no dot1x timeout server-timeout
```

Parameter

`<1-65535>`	Specify the authentication server response timeout.

Default

Default timeout is 30 seconds.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x timeout server-timeout 555

(config)#interface eth0
(config-if)#no dot1x timeout server-timeout
```

dot1x timeout supp-timeout

Use this command to set the interval for a supplicant to respond.

Use the `no` parameter to disable the authentication sever response timeout.

Command Syntax

```
dot1x timeout supp-timeout <1-65535>
no dot1x timeout supp-timeout
```

Parameter

`<1-65535>`	Specify the authentication server response timeout.

Default

Default timeout is 30 seconds.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x timeout supp-timeout 40

(config)#interface eth0
(config-if)#no dot1x timeout supp-timeout
```

dot1x timeout tx-period

Use this command to set the interval between successive attempts to request an ID.

Use the `no` parameter to disable the interval between successive attempts to request an ID.

Command Syntax

```
dot1x timeout tx-period <1-65535>
no dot1x timeout tx-period
```

Parameter

`<1-65535>`	Specify the authentication server response timeout.

Default

Default timeout is 30 seconds.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#dot1x timeout tx-period 34

(config)#interface eth0
(config-if)#no dot1x timeout tx-period
```

ip radius source-interface

Use this command to set the local address sent in packets to the radius server.

Use the `no` parameter to clear the local address.

Command Syntax

```
ip radius source-interface HOSTNAME PORT
no ip radius source-interface
```

Parameters

`HOSTNAME`	Specify the radius client in the dotted IP address, or in the hostname format.
`PORT`	Specify the radius client port number. The default port number is 1812.

Default

The default port number is 1812.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#ip radius source-interface myhost 1812

(config)#no ip radius source-interface
```

radius-server dot1x deadtime

Use this command to specify the number of minutes a radius server, which is not responding to authentication requests, is passed over by requests for radius authentication. To improve radius response times when some servers might be unavailable, use this command to cause the unavailable servers to be skipped immediately.

Use the `no` form of this command to set deadtime to the default value of 0.

Command Syntax

```
radius-server dot1x deadtime MIN
no radius-server dot1x deadtime
```

Parameter

`dot1x`	IEEE 802.1X Port-Based Access Control.
`MIN`	Length of time (in minutes) that a radius server is skipped over by transaction requests, up to a maximum of 1440 minutes (24 hours). Enter a value in the range 1 to 1440.

Default

Deadtime is set to 0

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#radius-server dot1x deadtime 10

(config)#no radius-server dot1x deadtime
```

radius-server dot1x host

Use this command to specify the IP address or host name of the remote radius server host and assign authentication and accounting destination port numbers. Multiple radius-server host commands can be used to specify multiple hosts. The software searches for hosts in the order they are specified. If no host-specific timeout, retransmit, or key values are specified, the global values apply to that host.

If the auth-port parameter is not specified, it will take the default value of the auth-port. If you do not specify the auth-port to unconfigure, and the default value of the auth-port does not match the port you are trying to unconfigure, the specified radius-server host will not be unconfigured.

Use the `no` form of the command to unconfigure a specified radius-server.

Command Syntax

```
radius-server dot1x host (A.B.C.D|HOSTNAME|X:X::X:X)(|(key ((0 WORD) | (7 WORD) |
  (WORD))(|(auth-port <0-65535> (|(timeout <1-60> (|(retransmit <1-100>)))))))
no radius-server dot1x host (A.B.C.D|HOSTNAME|X:X::X:X)(|(key ((0 WORD) | (7 WORD)
  | (WORD))(|(auth-port <0-65535> (|(timeout (|(retransmit <1-100>)))))))
```

Parameters

`dot1x`	IEEE 802.1X Port-Based Access Control.
`A.B.C.D`	IPv4 address of the RADIUS server.
`HOSTNAME`	Host name or DNS name of the RADIUS server.
`X:X::X:X`	IPv6 address of the RADIUS server.
`auth-port`	RADIUS server's port for authentication.
`key`	Specify the global shared key.
`retransmit`	Global RADIUS server retransmit count.
`timeout`	Specify the RADIUS server timeout(default: 5 seconds).
`0`	To specify shared key in clear-text form.
`7`	To specify shared key in encrypted form.
`WORD`	RADIUS shared secret(clear text) (Max Size 63).
`<0-65535>`	Port number.
`<0-100>`	Global RADIUS server retransmit count.
`<1-60>`	RADIUS server timeout period in seconds.

Default

The default value of auth-port is 1645.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#radius-server dot1x host hostname auth-port 1233 timeout 1 retransmit
2

(config)#no radius-server dot1x host hostname auth-port 1233
```

radius-server dot1x key

Use this command to set the shared secret key between a Radius server and a client.

Use the `no` form of the command to undo this configuration.

Command Syntax

```
radius-server dot1x key ((0 WORD) | (7 WORD) | (WORD))
no radius-server dot1x key ((0 WORD) | (7 WORD) | (WORD))
```

Parameter

`dot1x`	IEEE 802.1X Port-Based Access Control.
`0`	To specify shared key in clear-text form.
`7`	To specify shared key in encrypted form.
`WORD`	Shared secret among radius server and 802.1X client (Max Size 63).

Default

No default value is specified.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#radius-server dot1x key 0 abcd

#configure terminal
(config)#no radius-server dot1x 0 abcd
```

radius-server dot1x retransmit

Use this command to specify the number of times the router transmits each radius request to the server before giving up.

Use the `no` form of this command to disable retransmission.

Command Syntax

```
radius-server dot1x retransmit RETRIES
no radius-server dot1x retransmit
```

Parameter

`dot1x`	IEEE 802.1X Port-Based Access Control.
`RETRIES`	Specify the retransmit value. Enter a value in the range 1 to 100. If no retransmit value is specified, the global value is used.

Default

The default value is 3.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#radius-server dot1x retransmit 12

(config)#no radius-server dot1x retransmit
```

radius-server dot1x timeout

Use this command to specify the number of seconds a router waits for a reply to a radius request before retransmitting the request.

Use the `no` parameter to use the default value.

Command Syntax

```
radius-server dot1x timeout <1-60>
no radius-server dot1x timeout
```

Parameter

`dot1x`	IEEE 802.1X Port-Based Access Control.
`<1-60>`	RADIUS server timeout period in seconds.

Default

The default value is 5 seconds.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#radius-server dot1x timeout 20

#configure terminal
(config)#no radius-server dot1x timeout
```

show debugging dot1x

Use this command to display the status of the debugging of the 802.1x system.

Command Syntax

```
show debugging dot1x
```

Parameters

None

Command Mode

Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show debugging dot1x
802.1X debugging status:
```

show dot1x

Use this command to display IEEE 802.1x port-based access control information.

Command Syntax

```
show dot1x
show dot1x all
show dot1x diagnostics interface IFNAME
show dot1x interface IFNAME
show dot1x sessionstatistics interface IFNAME
show dot1x statistics interface IFNAME
```

Parameters

`all`	Display all IEEE 802.1x port-based access control information.
`diagnostics`	Display diagnostics information.
`IFNAME`	Interface name.
`sessionstatistics`	Display the statistics for a session.
`statistics`	Display the statistics.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following is an output of this command displaying the state of the system.

```
#show dot1x
% 802.1x authentication enabled
% Radius server address: 192.168.1.1.1812
% Radius client address: dhcp128.mySite.com.12103
% Next radius message id: 0
```

The following is an output of this command displaying detailed information for all ports.

```
#show dot1x all
% 802.1x authentication enabled
% Radius server address: 192.168.1.1.1812
% Radius client address: dhcp128.mySite.com.12103
% Next radius message id: 0
% Dot1x info for interface eth1 - 3
%  portEnabled: true - portControl: auto
%  portStatus: unauthorized - currentId: 11
%  reAuthenticate: disabled
%  abort:F fail:F start:F timeout:F success:F
%  PAE: state: connecting - portMode: auto
%  PAE: reAuthCount: 2 - rxRespId: 0
```

```
%  PAE: quietPeriod: 60 - reauthMax: 2 - txPeriod: 30
%  BE: state: idle - reqCount: 0 - idFromServer: 0
%  BE: suppTimeout: 30 - serverTimeout: 30 - maxReq: 2
%  CD: adminControlledDirections: in - operControlledDirections: in
%  CD: bridgeDetected: false
%  KR: rxKey: false
%  KT: keyAvailable: false - keyTxEnabled: false
```

The following tables describes the output of the `show dot1x` command.

Table 8-21: Port variables

Entry	Description
portEnabled	Interface operational status (Up-true/down-false)
portControl	Current control status of the port for 802.1x control
portStatus	802.1x status of the port (authorized/unauthorized)
reAuthenticate	Reauthentication enabled/disabled status on port
reAuthPeriod	Reauthentication period

Table 8-22: Supplicant PAE related global variables

Entry	Description
abort	Abort authentication when true
fail	Failed authentication attempt when false
start	Start authentication when true
timeout	Authentication attempt timed out when true
success	Authentication successful when true

Table 8-23: 802.1x Operational state of interface

Entry	Description
mode	Configured 802.1x mode
reAuthCount	Reauthentication count
quietperiod	Time between reauthentication attempts
reAuthMax	Maximum reauthentication attempts

Table 8-24: Backend authentication state machine variables and constants

Entry	Description
state	State of the port.
reqCount	Number of requests sent to server
suppTimeout	Number of seconds the port waits for a response when relaying a request from the authentication server to the supplicant before resending the request.
serverTimeout	Number of seconds the port waits for a reply when relaying a response from the supplicant to the authentication server before timing out.
maxReq	Maximum number of times a request packet is retransmitted to the supplicant before the authentication session times out.

Table 8-25: Controlled directions state machine

Entry	Description
adminControlledDirections	Administrative value (Both/In)
operControlledDirections	Operational Value (Both/In)

Table 8-26: KR -- Key receive state machine

Entry	Description
rxKey	True when EAPOL-Key message is received by supplicant or authenticator. false when key is transmitted

Table 8-27: Key Transmit state machine

Entry	Description
keyAvailable	False when key has been transmitted by authenticator, true when new key is available for key exchange
keyTxEnabled	Key transmission enabled/disabled status

snmp restart auth

Use this command to restart SNMP in Authentication

Command Syntax

```
snmp restart auth
```

Parameters

None

Default

No default value is specified.

Default

The default port is UDP 162.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#snmp restart auth
```

CHAPTER 9 Port Security Commands

This chapter describes the Port Security commands.

show port-security

Use this command to display Port Security configuration for all ports or for a particular interface.

Command Syntax

```
show port-security
show port-security (interface IFNAME |)
```

Parameters

IFNAME	Interface name

Default

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#show port-security
Port port-security mode MAC limit CVLAN SVLAN static secure MAC
-----------------------------------------------------------------
ge1  dynamic            3         2           0000.0000.1112
                                   10          0000.0000.3333


#show port-security interface ge1

Port Security Mode : Dynamic
Secure MAC limit : 3
Static Secure MAC list :
CVLAN SVLAN MAC Address
---------------------------
2           0000.0000.1112
10          0000.0000.3333
```

switchport port-security

Use this command to enable Port Security on an interface.

Use the no parameter with this command to disable Port Security on an interface. This command removes configured secured MAC, if any, on this interface.

Note: This command is supported for physical, LAG, and MLAG (active) interfaces only. Enabling port security on an interface removes learned MAC addresses of interfaces (whether learned by static or dynamic means), and then relearns the secure MAC addresses. Multicast MAC addresses are not considered as part of the MAC learning limit.

Note: This command is ignored when port security is already enabled on an interface.

Command Syntax

```
switchport port-security (static |)
no switchport port-security
```

Parameters

`static`	Static mode of Port Security.

Default

By default this feature is disabled, the default mode of Port Security is to dynamically learn. In dynamic mode, devices learn MAC addresses dynamically. Users can program static MACs, however, dynamic MAC learning will not be allowed in static mode for port security.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#configure terminal
(config)#interface ge1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode hybrid
(config-if)#switchport hybrid allowed vlan all
(config-if)#switchport port-security
```

switchport port-security logging enable

Use this command to enable violated MAC logging on a port security enabled interface.

Use the `no` parameter with this command to disable violated mac logging on a port security enabled interface.

Command Syntax

```
switchport port-security logging enable
no switchport port-security logging
```

Parameters

None

Default

By default logging is disabled.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#configure terminal
(config)#interface ge1
(config-if)#switchport port-security logging enable
```

switchport port-security mac-address

Use this command to add static secure MAC addresses.

Use the `no` parameter to remove static secure MAC addresses.

Command Syntax

```
switchport port-security mac-address XXXX.XXXX.XXXX
no switchport port-security mac-address XXXX.XXXX.XXXX
switchport port-security mac-address XXXX.XXXX.XXXX vlanId <2-4094>
no switchport port-security mac-address XXXX.XXXX.XXXX vlanId <2-4094>
```

Parameters

`XXXX.XXXX.XXXX`	Static secure MAC
`<2-4094>`	VLAN identifier

Default

NA

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#configure terminal
(config)#interface ge1
(config-if)#switchport port-security mac-address 0000.0000.1112 vlan 2
```

switchport port-security maximum

Use this command to configure MAC learn limit for an interface.

Note: When a newly configured max learn limit is less than the previous value, the user must remove/flush-out the unwanted MACs to stop traffic forwarding from the unwanted Source MAC addresses. MAC addresses can be removed using "`clear mac address-table`"

Command Syntax

```
switchport port-security maximum <1-1000>
```

Parameters

`<1-1000>`	Port security maximum learn limit

Default

Default learn limit is 1.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 1.3.6.

Examples

```
#configure terminal
(config)#interface ge1
(config-if)#switchport port-security maximum 3
```

CHAPTER 10 Layer 2 Control Protocols Tunneling Commands

This chapter is a reference for the Layer 2 Control Protocols (L2CP) tunneling commands:

clear l2protocol interface counters

This command allows you to clear the counters for numbers of packets peered, discarded and tunneled.

Command Syntax

```
clear l2protocol interface (IFNAME|) counters (peer|discard|tunnel|tunnel-discard|)
```

Parameters

`peer`	Clear stats for Peer protocol packets.
`discard`	Clear stats for Tunnel protocol packets.
`tunnel`	Clear stats for Tunnel protocol packets.
`tunnel-discard`	Clear stats for Tunnel discard protocol packets.

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS-SP version 1.0.

Examples

```
# clear l2protocol interface xe1 counters peer
```

l2protocol

This command allows you to change the process of protocol to peer/discard/tunnel.

Command Syntax

```
l2protocol (stp|lacp|efm|elmi|lldp|synce)(peer|discard|tunnel)
```

Parameters

`stp`	Spanning Tree Protocols.
`lacp`	Link Aggregation (LACP).
`efm`	Ethernet first mile (Link OAM).
`elmi`	Ethernet local management interface.
`lldp`	Link layer discovery protocol.
`synce`	Link layer discovery protocol.
`peer`	Act as peer to the customer Device instance of the protocol.
`discard`	Discard the protocol data unit.
`tunnel`	Tunnel the Protocol data unit into the SVLAN.

Default

Default process value is peer.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS-SP version 1.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode customer-edge access
(config-if)#l2protocol stp tunnel
(config-if)#l2protocol stp peer
(config-if)#l2protocol stp discard
```

l2protocol encapsulation dest-mac

Use this command to change destination mac of tunneled l2 protocol packet. Allowed mac are 0100.C2CD.CDD0 or 0104.DFCD.CDD0.

Use the `no` parameter with this command to set default mac 0100.C2CD.CDD0.

Note: This command only applies to provider bridging. For more information, see Chapter 14, *Provider Bridging Configuration*.

Command Syntax

```
bridge <1-32> l2protocol encapsulation dest-mac XXXX.XXXX.XXXX
no bridge <1-32> l2protocol encapsulation dest-mac
```

Parameters

`bridge`	Bridge group for bridging.
`<1-32>`	<1-32>
`l2protocol`	Configure Layer2 Protocol Tunneling.
`encapsulation`	Encapsulation of L2PT packet.
`dest-mac`	Encapsulation with destination mac.
`XXXX.XXXX.XXXX`	Destination Mac-address of L2PT tunneling (0100.C2CD.CDD0 or 0104.DFCD.CDD0).

Command Mode

Configuration mode

Applicability

This command is introduced in OcNOS-SP version 1.0.

Examples

```
(config)#bridge 1 l2protocol encapsulation dest-mac ?
XXXX.XXXX.XXXX Destination Mac-address of L2PT tunneling (0100.C2CD.CDD0 or
0104.DFCD.CDD0)
(config)#bridge 1 l2protocol encapsulation dest-mac 0104.DFCD.CDD1
L2PT destination mac should be 0100.C2CD.CDD0 or 0104.DFCD.CDD0
(config)#bridge 1 l2protocol encapsulation dest-mac 0104.DFCD.CDD0
(config)#bridge 1 l2protocol encapsulation dest-mac 0100.C2CD.CDD0
(config)#bridge 1 l2protocol encapsulation dest-mac 0100.C2CD.CDD1
L2PT destination mac should be 0100.C2CD.CDD0 or 0104.DFCD.CDD0
(config)#

(config)#no bridge 1 l2protocol encapsulation dest-mac
(config)#show running-config | in bridge
bridge 1 protocol provider-rstp edge
vlan 2-10 type customer bridge 1 state enable
vlan 11-12 type service point-point bridge 1 state enable
cvlan registration table map1 bridge 1
bridge-group 1
bridge-group 1
(config)#
```

show l2protocol interface counters

This command allows you to display the counters for numbers of packets peered, discarded and tunneled.

Command Syntax

```
show l2protocol interface (IFNAME|) counters (peer|discard|tunnel|tunnel-discard|)
```

Parameters

`peer`	Display stats for Peer protocol packets.
`discard`	Display stats for Tunnel protocol packets.
`tunnel`	Display stats for Tunnel protocol packets.
`tunnel-discard`	Display stats for Tunnel discard protocol packets.

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS-SP version 1.0.

Examples

```
# show l2protocol interface xe1 counters peer
Interface xe1
Peer:     stp:    1

# show l2protocol interface xe1 counters
Interface xe1
Peer:     stp:    1
Discard:  stp:    10
Tunnel:   stp:    5
```

show l2protocol processing interface

This command allows you to display the processing information on Layer 2 protocol interface.

Command Syntax

```
show l2protocol processing interface IFNAME
```

Parameters

IFNAME	Interface name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command is introduced was before OcNOS-SP version 1.0.

Examples

```
#show l2protocol processing interface xe1/1
Bridge    Interface Name                  Protocol       Processing Status
======    ==============                  ========       =================
1         xe1/1                            stp            Tunnel
1         xe1/1                            gmrp           Peer
1         xe1/1                            gvrp           Peer
1         xe1/1                            mmrp           Peer
1         xe1/1                            mvrp           Peer
1         xe1/1                            lacp           Peer
1         xe1/1                            lldp           Peer
1         xe1/1                            efm            Peer
1         xe1/1                            elmi           Peer
1         xe1/1                            ptp            Peer
1         xe1/1                            synce          Peer
```

CHAPTER 11 Provider Bridging Commands

This chapter describes the Provider Bridging (PB) commands.

IEEE 802.1ad standardizes the architecture and bridged protocols to allow Ethernet frames with multiple VLAN tags. Packets through a provider network are doubly tagged with both an:

- Inner (C-VLAN) tag which is the customer network VLAN identifier
- Outer (S-VLAN) tag which is the service provider network VLAN identifier

bridge protocol provider-mstp

Use this command to create a provider multiple spanning-tree protocol (MSTP) bridge. MSTP bridges can have different spanning-tree topologies for different VLANs inside a region of similar MSTP bridges.

Using this command creates an instance of the spanning tree, and associates the VLANs specified with that instance. A bridge created by this command forms its own separate region.

The multiple spanning tree protocol, like the rapid spanning tree protocol, provides rapid reconfiguration features, while providing load-balancing capability.

Command Syntax

```
bridge <1-32> protocol provider-mstp (edge|)
```

Parameters

`<1-32>`	Bridge identifier.
`edge`	Configure as an edge bridge.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 2 protocol provider-mstp edge
```

bridge protocol provider-rstp

Use this command to add an IEEE 802.1D-2004 Rapid Spanning Tree Protocol (RSTP) bridge.

After creating a bridge instance, add interfaces to the bridge using the `bridge-group` command. Bring the bridge instance into operation with the `no shutdown` command in interface mode.

Command Syntax

```
bridge <1-32> protocol provider-rstp (edge|)
```

Parameters

`<1-32>`	Bridge identifier.
`edge`	Configure as an edge bridge.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#bridge 2 protocol provider-rstp edge
```

cvlan registration table

Use this command to create a customer VLAN (CVLAN) registration table that maps between CVLANs and service provider VLANs (SVLANs).

Use the `no` parameter with this command to delete the CVLAN registration table.

Command Syntax

```
cvlan registration table WORD bridge <1-32>
no cvlan registration table WORD bridge <1-32>
```

Parameters

`WORD`	Name of the CVLAN registration table.
`<1-32>`	Specify a bridge ID.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#cvlan registration table customer1
(config-cvlan-registration)#
```

cvlan svlan

Use this command to map one or more customer VLANs (CVLANs) to a service provider VLAN (SVLAN).

To update the optional QoS parameters cos-to-queue and remark-cos, execute the complete command along with the optional parameters. To remove these options, execute the same command by removing the optional parameters.

Refer `qos profile` commands from configuration guide for more details about qos profiles.

Use the `no` forms of this command to delete a mapping.

Command Syntax

```
cvlan VLAN_RANGE2 (cvlan VLAN_ID|) svlan VLAN_ID ({untagged-pep|untagged-
  cep}|)({cos-to-queue NAME | remark-cos}|)
no cvlan VLAN_RANGE2  svlan VLAN_ID
```

Parameters

`cvlan`	CVLAN
`VLAN_RANGE2`	VLAN identifier <1-4094> or range such as 2-5,10 or 2-5,7-19
`cvlan`	Translation of CVID
`VLAN_ID`	Translated CVID <1-4095>
`svlan`	SVLAN corresponding to the C-VLAN
`VLAN_ID`	VLAN identifier 1-4094>
`untagged-pep`	Provider edge port is untagged for this CVLAN
`untagged-cep`	Customer edge port is untagged for this CVLAN
`cos-to-queue`	Configure cos-to-queue map for cvlan
`NAME`	Ingress profile to modify queue/color on basis of c-cos
`remark-cos`	Remark Egress COS

Command Mode

CVLAN Registration mode

Applicability

This command was introduced before OcNOS version 1.3 and updated in OcNOS-SP version 1.0.

Example

```
#configure terminal
(config)#cvlan registration table customer1 bridge 1
(config-cvlan-registration)#cvlan 2 svlan 3
(config-cvlan-registration)#cvlan 3 svlan 3 cos-to-queue c1 remark-cos
(config-cvlan-registration)#cvlan 100 cvlan 101 svlan 200 cos-to-queue p1
remark-cos
(config-cvlanregistration)#cvlan 3 svlan 3 remark-cos
(config-cvlan-registration)#cvlan 4 svlan 5 untagged-pep
(config-cvlan-registration)#cvlan 5 svlan 6 untagged-cep
(config-cvlan-registration)#no cvlan 3 svlan 3
```

```
(config-cvlan-registration)#cvlan 23 svlan 31 untagged-pep untagged-cep cos-
to-queue p1 remark-cos
(config-cvlan-registration)#cvlan 15-16 svlan 18 untagged-cep remark-cos
```

dotad

This command allows you to change the TPID for a port.

Use the no form of this command to unset the TPID to default value.

Command Syntax

```
dotad ethertype ETHERTYPE
no dotad ethertype
```

Parameters

dotad	Set the switching characteristics of the Layer2 dot1q header.
ETHERTYPE	Ethertype value for outer tag (Allowed ethertype values are 0x8100 (default) or 0x88a8 0r 0x9100 or 0x9200)

Default

The default TPID value is 8100.

Command Mode

Interface Mode

Applicability

This command was introduced before OcNOS-SP version 1.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)# dotad ethertype 0x88a8
(config-if)# no dotad ethertype
```

show cvlan registration table

Use this command to display the CVLAN registration table.

Command Syntax

```
show cvlan registration table (WORD|bridge <1-32>|WORD bridge <1-32>|)
```

Parameters

WORD	CVLAN registration table name.
<1-32>	Bridge identifier

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#sh cvlan registration table bridge 1
Bridge          Table Name       Port List
======          ==========       =========
  1               map              xe17

CVLAN ID      T-CVLAN ID     SVLAN ID     Profile Name    Egress remark-Cos
 ========    ==========     ========    =============    =================
 100             101            200          p1              Yes
```

Table 11-28 explains the output fields.

Table 11-28: show cvlan registration table output

Entry	Description
Bridge	ID number of the bridge associated with the Customer VLAN (CVLAN).
Table Name	ID of the CVLAN registration table.
Port List	List of ports used by this CVLAN (including Link aggregators).
CVLAN ID	ID number of the CVLAN.
T-CVLAN ID	Translation CVLAN ID.
SVLAN ID	ID number of the Service VLAN (SVLAN) associated with the CVLAN.
Profile Name	cos-to-queue profile name.
Egress remark-Cos	Remark Egress Cos

switchport customer-edge

Use this command to set the switching characteristics of the layer 2 interface and the default customer VLAN.

Use the `no` form of this command to remove a customer VLAN.

Command Syntax

```
switchport customer-edge (access|hybrid) vlan <2-4094>
no switchport customer-edge (access|hybrid) vlan
```

Parameters

`access`	Set the layer 2 interface as access.
`hybrid`	Set the layer 2 interface as hybrid.
`<2-4094>`	Set the default VID for the interface.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#switchport customer-edge access vlan 3

(config)#interface eth0
(config-if)#no switchport customer-edge access vlan
```

switchport customer-edge hybrid

Use this command to set the switching characteristics of the Layer 2 customer-facing interface to hybrid. Both tagged and untagged frames will be classified over hybrid interfaces.

Command Syntax

```
switchport customer-edge hybrid allowed vlan add VLAN_ID
switchport customer-edge hybrid allowed vlan remove VLAN_ID
switchport customer-edge hybrid allowed vlan all
switchport customer-edge hybrid allowed vlan none
```

Parameters

`add`	Add a VLAN to transmit and receive through the Layer 2 interface.
`VLAN_ID`	ID of the VLAN <2-4094>.
`remove`	Remove a VLAN from the member set.
`VLAN_ID`	ID of the VLAN <2-4094>.
`all`	Allow all VLANs to transmit and receive through the Layer 2 interface.
`none`	Allow no VLANs to transmit and receive through the Layer 2 interface.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#interface eth0
(config-if)#switchport customer-edge hybrid allowed vlan add 2
```

switchport customer-edge trunk

Use this command to set the Layer2 interface as trunk.

Command Syntax

```
switchport customer-edge trunk allowed vlan add VLAN_ID
switchport customer-edge trunk allowed vlan remove VLAN_ID
switchport customer-edge trunk allowed vlan all
switchport customer-edge trunk allowed vlan none
```

Parameters

`add`	Add a VLAN to the member set.
`VLAN_ID`	Specify a VLAN ID <2-4094>
`remove`	Remove a VLAN from the member set.
`all`	Allow all VLANs to transmit and receive through the Layer 2 interface.
`none`	Allow no VLANs to transmit and receive through the Layer 2 interface.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#switchport customer-edge trunk allowed vlan add 12
```

switchport customer-edge vlan registration

Use this command to configure the VLAN registration parameters.

Use the `no` parameter with this command to delete the mapping from the interface.

Command Syntax

```
switchport customer-edge vlan registration WORD
no switchport customer-edge vlan registration
```

Parameters

`WORD`	Name of the CVLAN registration table.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#switchport customer-edge vlan registration customer1
```

switchport customer-network allowed vlan

Use this command to add SVLAN IDs to the Customer Network Port.

Command Syntax

```
switchport customer-network allowed vlan add VLAN_RANGE
```

Parameters

VLAN_RANGE	VLAN identifier <1-4094> or range such as 2-5,10 or 2-5,7-19.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 6.2.0.

Examples

In this example, the xe1 interface allows S-TAG 100-200 and 400 traffic from customer.

```
(config)#interface xe1
(config-if)#switchport
(config-if)#dot1ad ethertype 0x88a8
(config-if)#bridge-group 1
(config-if)#switchport mode customer-network
    (config-if)#switchport customer-network allowed vlan add 100-200,400
```

switchport customer-network vlan

Use this command to set the default SVLAN ID for the Customer Network Port.

Command Syntax

```
switchport customer-network vlan <2-4094>
no switchport customer-network vlan
```

Parameters

`<2-4094>`	Set the default VLAN ID for the interface.

Default

Default Customer Network VLAN is 1.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 6.2.0

Examples

In this example, the xe1 interface allows C-TAG/untagged traffic from customers, adding SVLAN ID 100 before forwarding to the provider network. While egressing out, the SVLAN ID 100 will be stripped out.

```
(config)#interface xe1
(config-if)#switchport
(config-if)#dot1ad ethertype 0x88a8
(config-if)#bridge-group 1
(config-if)#switchport mode customer-network
(config-if)#switchport customer-network allowed vlan add 100
(config-if)#switchport customer-network vlan 100
```

switchport mode

Use this command to set the switching characteristics of the Layer 2 interface.

Command Syntax

```
switchport mode (provider-network|customer-edge|customer-network)
```

Parameters

`provider-network`	Provider network.
`customer-edge`	Customer edge.
`customer-network`	Customer network.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode provider-network
```

switchport mode customer-edge

Use this command to set the switching characteristics of the Layer 2 customer facing interface and classify only untagged frames. Received frames are classified based on the VLAN characteristics, then accepted or discarded based on the specified filtering criteria.

Command Syntax

```
switchport mode customer-edge (access|hybrid|trunk)
```


```
switchport mode customer-edge (access|hybrid|trunk)
```


Parameters

`access`	Set the layer 2 interface as access.
`hybrid`	Set the layer 2 interface as hybrid.
`trunk`	Set the layer 2 interface as trunk.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode customer-edge access
```

switchport mode customer-edge hybrid acceptable-frame-type

Use this command to set the layer 2 interface acceptable frames types. This processing occurs after VLAN classification.

Command Syntax

```
switchport mode customer-edge hybrid acceptable-frame-type (all|vlan-tagged)
```

Parameters

`all`	Set all frames can be received.
`vlan-tagged`	Set only VLAN-tagged frames can be received.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth0
(config-if)#switchport mode customer-edge hybrid acceptable-frame-type vlan-
tagged
```

switchport provider-network

Use this command to set the switching characteristics of the provider-network interface.

Command Syntax

```
switchport provider-network allowed vlan add VLAN_RANGE2
switchport provider-network allowed vlan remove VLAN_RANGE2
switchport provider-network allowed vlan except VLAN_RANGE2
switchport provider-network allowed vlan all
switchport provider-network allowed vlan none
```

Parameters

`add`	Add a VLAN to transmit and receive through the Layer 2 interface.
`VLAN_RANGE2`	VLAN ID 1-4094 or range(s): 2-5 10 or 2-5 7-20.
`remove`	Remove a VLAN from the member set.
`VLAN_RANGE2`	VLAN ID 1-4094 or range(s): 2-5 10 or 2-5 7-20.
`Except`	All VLANs except these VLANs are part of the member set.
`VLAN_RANGE2`	VLAN ID 1-4094 or range(s): 2-5 10 or 2-5 7-20.
`all`	Allow all VLANs to transmit and receive through the Layer 2 interface.
`none`	Allow no VLANs to transmit and receive through the Layer 2 interface.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#interface eth0
(config-if)#switchport provider-network allowed vlan add 2
```

switchport provider-network isolated-vlan

Use this command to attach a VLAN as an isolated VLAN for a provider network port.

Using an isolated VLAN for PNP ports on a switch can forward all frames received from the PNP port to all other PNP ports. However, if VLANs are configured to be isolated, they can traverse PNP port without sharing any of their frames.

Use the `no` form of this command to remove an isolated VLAN for a provider network port.

Command Syntax

```
switchport provider-network isolated-vlan VLAN_RANGE
no switchport provider-network isolated-vlan VLAN_RANGE
```

Parameters

`VLAN_RANGE`	VLAN identifier <2-4094> or range such as 2-5,10 or 2-5,7-19

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS-SP version 1.0.

Example

```
#configure terminal
(config)#bridge 1 protocol provider-rstp
(config)#vlan database
(config-vlan)#vlan 2-10 type service point-point bridge 1 state enable
(config-vlan)#exit
(config)#interface xe0
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport provider-network allowed vlan all
(config-if)#switchport provider-network isolated-vlan 2-10
```

switchport provider-network vlan translation

Use this command to add a translation table entry for CVLAN and SVLAN on a provider network port.

Use the `no` form of this command to delete a translation table entry for CVLAN and SVLAN on a provider network port.

Command Syntax

```
switchport provider-network vlan translation (cvlan <2-4094>| ) svlan <2-4094>
  (cvlan <2-4094> | ) svlan <2-4094>
no switchport (provider-network) vlan translation svlan VLAN_ID svlan VLAN_ID
no switchport (provider-network) vlan translation cvlan <1-4095> svlan <1-4095>
```

Parameters

`cvlan`	CVLAN to translate
`<2-4094>`	CVLAN identifier to translate
`svlan`	SVLAN to translate
`<2-4094>`	SVLAN identifier to translate
`cvlan`	Translated CVLAN
`<2-4094>`	Translated CVLAN identifier
`svlan`	Translated SVLAN
`<2-4094>`	Translated SVLAN identifier
`scos`	Class of Service in the Priority Code Point (PCP) field of the service provider tag (STAG)
`<0-7>`	Class-of-service value
`scfi`	Canonical Format Indicator in the Drop Eligible Indicator (DEI) field of the STAG
`<0-1>`	Canonical Format Indicator value
`ccos`	Class of Service in the PCP field of the customer tag (CTAG)
`<0-7>`	Class-of-service value
`ccfi`	Canonical Format Indicator in the DEI field of the CTAG
`<0-1>`	Canonical Format Indicator value

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#interface eth1
(config-if)#switchport
(config-if)#bridge-group 1
(config-if)#switchport mode provider-network
(config-if)#switchport provider-network allowed vlan all
```

```
(config-if)#switchport provider-network vlan translation cvlan 2 svlan 3 cvlan
4 svlan 5
```

vlan type

This command allows you to create a single/range of VLAN's on provide/edge bridge.

Use the no form of this command to delete the VLAN.

Command Syntax

```
vlan VLAN_RANGE type customer bridge <1-32>
vlan VLAN_RANGE type customer bridge <1-32> name WORD
vlan VLAN_RANGE type customer bridge <1-32> state (enable | disable)
vlan VLAN_RANGE type service point-point bridge <1-32>
vlan VLAN_RANGE type service point-point bridge <1-32> name WORD
vlan VLAN_RANGE type service point-point bridge <1-32> state (enable | disable)

no vlan VLAN_RANGE type customer bridge <1-32>
no vlan VLAN_RANGE type service bridge <1-32>
```

Parameters

VLAN_RANGE	VLAN identifier <2-4094> or range such as 2-5,10 or 2-5,7-19
customer	Identifies the Customer VLAN
bridge	Specify the bridge group ID in the range <1-32>.
name	The ASCII name of the VLAN. Maximum length allowed is 16 characters.
point-point	Sets the VLAN connectivity mode to point-to-point
WORD	ASCII name of the VLAN.
state	Indicates the operational state of the VLAN.
enable	Sets VLAN into an enable state.
disable	Sets VLAN into a disable state.

Command Mode

Configuration Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)vlan 2,4,5-6 customer bridge 2
(config)vlan 10-12 service type point-point bridge 3
```

vlan type customer

Use this command to configure VLANs of type customer, to enable or disable the state of the VLANs, and to configure the name for VLANs.

Use the `no` form of this command to remove the VLAN type.

Command Syntax

```
vlan <2-4094> type customer bridge <1-32>
vlan <2-4094> type customer bridge <1-32> state (enable|disable)
vlan <2-4094> type customer bridge <1-32> name WORD
no vlan <2-4094> type customer bridge <1-32>
```

Parameters

`<2-4094>`	The VID of the VLAN that will be enabled or disabled on the bridge <2-4094>.
`type`	Identifies the VLAN as a customer, service, or VLAN.
`customer`	Identifies the Customer VLAN
`bridge`	Indicates a Service VLAN <1-32>.
`name`	The ASCII name of the VLAN. Maximum length allowed is 16 characters.
`state`	Indicates the operational state of the VLAN.
`enable`	Sets VLAN into an enable state.
`disable`	Sets VLAN into a disable state.
`WORD`	ASCII name of the VLAN.

Command Mode

VLAN Configuration mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#vlan database
(config-vlan)#vlan 12 type customer bridge 1 name new state enable
```

CHAPTER 12 Link Layer Discovery Protocol v2 Commands

The commands in this chapter support:

- Link Layer Discovery Protocol (LLDP) version 2 as described in IEEE 802.1AB 2009
- LLDP-MED protocol extension as per ANSI/TIA-1057 April 2006.

Note: To enable LLDPv2, LLDP (previous version) should be disabled or vice versa.

clear lldp counters

Use this command to clear the LLDP statistics on all the interfaces.

Command Syntax

```
clear lldp counters
```

Parameters

`counters`	Reset the LLDP traffic counters to zero.

Command Mode

Exec Mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#clear lldp counters
```

lldp-agent

Use this command to create an LLDP agent mode.

Note: This command is not supported in SVLAN, VLAN, and loopback interfaces.

Use the `no` parameter to remove configured lldp agent mode.

Command Syntax

```
lldp-agent (non-tpmr-bridge |customer-bridge| )
no lldp-agent (non-tpmr-bridge |customer-bridge| )
```

Parameters

`non-tpmr-bridge`

non-tpmr-bridge

`customer-bridge`

customer-bridge

Default

By default LLDP agent is disabled.

Command Mode

Interface Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent customer-bridge
(if-lldp-agent)#

(if-lldp-agent)#no lldp-agent customer-bridge
(if-lldp-agent)#exit
(config-if)#
```

debug lldp

Use this command to set the debugging functions for LLDP.

Use the no form of this command to turn off LLDP debugging functions

Command Syntax

```
debug lldp (event|ha|rx|tx|message)
no debug lldp (event|ha|rx|tx|message)
```

Parameters

`event`	Enable or disable event debugging
`ha`	Enable or disable high availability debugging
`rx`	Enable or disable RX debugging
`tx`	Enable or disable TX debugging
`message`	Enable or disable NSM message debugging

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#debug lldp event
#debug lldp message
```

lldp run

Use this command to start the Link Layer Discovery Protocol (LLDP)

Use the no form of this command to stop LLDP

Command Syntax

```
lldp run
no lldp run
```

Parameters

None

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#configure terminal
(config)#lldp run

(config)#no lldp run
```

lldp tlv basic-mgmt

Use this command to select and unselect basic management TLVs in LLDP frames at the interface agent level. This command has precedence over the global configurations for inclusion of TLVs in LLDP frames.

Use the `no` parameter to remove the basic management TLV select/unselect configuration from the interface agent level.

Command Syntax

```
lldp tlv basic-mgmt (management-address|port-description|system-
  capabilities|system-description|system-name) (select|unselect)
no lldp tlv basic-mgmt (management-address|port-description|system-
  capabilities|system-description|system-name)
```

Parameters

`management-address`	Management address TLV
`port-description`	Port description TLV
`system-capabilities`	System capabilities TLV
`system-description`	System Description TLV
`system-name`	System name TLV
`select`	Select the LLDP TLV to send
`unselect`	Unselect the LLDP TLV to send

Default Value

None

Command Mode

LLDP agent mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)lldp-agent
(if-lldp-agent)#lldp tlv basic-mgmt system-name select
(if-lldp-agent)#exit
```

lldp tlv med

Use this command to select and unselect Media Endpoint Devices (MED) TLVs in LLDP frames at the interface agent level. This command has precedence over the global configurations for inclusion of TLVs in LLDP frames.

LLDP MED TLVs determine the capabilities the connected device supports and the capabilities the device has enabled.

Use the `no` parameter to remove the MED TLV select/unselect configuration from the interface agent level.

Command Syntax

```
lldp tlv med (network-policy|location|inventory|media-capabilities|extended-power-via-mdi) (select|unselect)
no lldp tlv med (network-policy|location|inventory|media-capabilities|extended-power-via-mdi)
```

Parameters

`network-policy`	Network-policy TLV
`location`	Location TLV
`inventory`	Inventory TLV
`media-capabilities`	Media-capabilities TLV
`extended-power-via-mdi`	Extended-power-via-mdi TLV (when PoE is available)
`select`	Select the LLDP TLV to send
`unselect`	Unselect the LLDP TLV to send

Default Value

None

Command Mode

LLDP agent mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)lldp-agent
(if-lldp-agent)#lldp tlv med network-policy select
(if-lldp-agent)#exit
```

lldp tlv ieee-8021-org-specific

Use this command to select and unselect ieee-8021-org-specific TLVs in LLDP frames at the interface agent level. This command has precedence over the global configurations for inclusion of TLVs in LLDP frames.

Use the `no` parameter to remove the ieee-8021-org-specific TLV select/unselect configuration from the interface agent level.

Command Syntax

```
lldp tlv ieee-8021-org-specific (link-agg|mgmt-vid|port-ptcl-vlanid|port-
  vlanid|ptcl-identity|vid-digest|vlan-name) (select|unselect)
no lldp tlv ieee-8021-org-specific {port-vlanid| port-ptcl-vlanid| vlan-name|ptcl-
  identity|vid-digest|mgmt-vid|link-agg}
```

Parameters

`link-agg`	Link-aggregation TLV
`mgmt-vid`	Management VLAN identifier TLV
`port-ptcl-vlanid`	Port protocol VLAN identifier TLV
`port-vlanid`	Port VLAN identifier TLV
`ptcl-identity`	Protocol-identifier TLV
`vid-digest`	VLAN identifier digest TLV
`vlan-name`	VLAN name TLV
`select`	Select the LLDP TLV to send
`unselect`	Unselect the LLDP TLV to send

Default Value

None

Command Mode

LLDP agent mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)lldp-agent
(if-lldp-agent)#lldp tlv ieee-8021-org-specific port-vlanid select
(if-lldp-agent)#exit
```

lldp tlv ieee-8023-org-specific

Use this command to select and unselect ieee-8023-org-specific TLVs in LLDP frames at the interface agent level. This command has precedence over the global configurations for inclusion of TLVs in LLDP frames.

Use the `no` parameter to remove the ieee-8023-org-specific TLV select/unselect configuration from the interface agent level.

Command Syntax

```
lldp tlv ieee-8023-org-specific (mac-phy| power-via-mdi| max-mtu-size)
  (select|unselect)
no lldp tlv ieee-8023-org-specific (mac-phy| power-via-mdi| max-mtu-size)
```

Parameters

`mac-phy`	Provider edge port VLAN ID TLV
`power-via-mdi`	Power-via-MDI TLV (when PoE is available)
`max-mtu-size`	Maximum MTU size TLV
`select`	Select the LLDP TLV to send
`unselect`	Unselect the LLDP TLV to send

Default Value

None

Command Mode

LLDP agent mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)lldp-agent
(if-lldp-agent)#lldp tlv ieee-8023-org-specific mac-phy select
(if-lldp-agent)#exit
```

lldp tlv-select basic-mgmt

Use this command to select basic management TLVs to be include in the LLDP frames.

Use the `no` parameter to disable basic management TLVs.

Command Syntax

```
lldp tlv-select basic-mgmt (management-address|port-description|system-
  capabilities|system-description|system-name)
no lldp tlv-select basic-mgmt (management-address|port-description|system-
  capabilities|system-description|system-name)
```

Parameters

`management-address`
: Management address specific TLV

`port-description`
: Port description specific TLV

`system-capabilities`
: System capabilities specific TLV

`system-description`
: System Description specific TLV

`system-name`
: System name specific TLV

Default Value

None

Command Mode

Configuration mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#lldp tlv-select basic-mgmt system-name
```

lldp tlv-select ieee-8021-org-specific

Use this command to select ieee-8021-org-specific TLVs to include in the LLDP frames.

Use the `no` parameter to disable ieee-8021-org-specific TLVs.

Command Syntax

```
lldp tlv-select ieee-8021-org-specific (link-agg|mgmt-vid|port-ptcl-vlanid|port-vlanid|ptcl-identity|vid-digest|vlan-name)
no lldp tlv-select ieee-8021-org-specific {port-vlanid| port-ptcl-vlanid| vlan-name|ptcl-identity| vid-digest|mgmt-vid|link-agg}
```

Parameters

`link-agg`	Link-aggregation TLV
`mgmt-vid`	Management VLAN identifier TLV
`port-ptcl-vlanid`	Port protocol VLAN identifier TLV
`port-vlanid`	Port VLAN identifier TLV
`ptcl-identity`	Protocol-identifier TLV
`vid-digest`	VLAN identifier digest TLV
`vlan-name`	VLAN name TLV

Default Value

None

Command Mode

Configuration mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#lldp tlv-select ieee-8021-org-specific port-vlanid
```

lldp tlv-select ieee-8023-org-specific

Use this command to select ieee-8023-org-specific TLVs to be include in LLDP frames.

Use the `no` parameter to disable ieee-8023-org-specific TLVs.

Command Syntax

```
lldp tlv-select ieee-8023-org-specific (mac-phy| power-via-mdi| max-mtu-size)
no lldp tlv-select ieee-8023-org-specific (mac-phy| power-via-mdi| max-mtu-size)
```

Parameters

`mac-phy`	VLAN ID Of the provider edge port <2-4094>.
`power-via-mdi`	Power-via-MDI (only when PoE feature is available)
`max-mtu-size`	Maximum MTU size TLV

Default Value

None

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS-SP version 3.0.

Examples

```
#configure terminal
(config)#lldp tlv-select ieee-8023-org-specific mac-phy
```

set lldp agt-circuit-id

Use this command to configure LLDP agt-circuit-id.

Command Syntax

```
set lldp agt-circuit-id  VALUE
```

Parameters

VALUE	Specify LLDP global agt-circuit ID.

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#interface eth0
(config-if)#set lldp agt-circuit-id sample
```

set lldp chassis-id-tlv

Use this command to set the chassis ID subtype for the LLDP agent on a port.

Use no form of this command to unset the chassis ID subtype.

Command Syntax

```
set lldp chassis-id-tlv (if-alias | ip-address | mac-address | if-name | locally-
  assigned)
no set lldp chassis-id-tlv
```

Parameters

`mac-address`	Use the MAC address as the chassis ID
`ip-address`	Use the management IP address as the chassis ID
`if-alias`	Use the IP address as the chassis ID
`if-name`	Use the interface name as the chassis ID
`locally-assigned`	Use the locally assigned value as the chassis ID

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp chassis-id-tlv ip-address
(if-lldp-agent)#no set lldp chassis-id-tlv
```

set lldp chassis locally-assigned

Use this command to set the locally assigned chassis name for the LLDP interface.

Command Syntax

```
set lldp chassis locally-assigned NAME
```

Parameters

NAME	Name assigned to the chassis.

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#set lldp chassis locally-assigned box1
```

set lldp disable

Use this command to disable the admin status of a LLDP agent on a port.

Command Syntax

```
set lldp disable
```

Parameters

None

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp disable
(if-lldp-agent)#exit
```

set lldp enable

Use this command to set the admin status of a LLDP agent on a port.

Command Syntax

```
set lldp enable (txonly|txrx|rxonly)
```

Parameters

`rxonly`	Receive-only
`txonly`	Transmit-only
`txrx`	Transmit and receive

Default

By default, no LLDP agent is enabled for a port.

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp enable txrx
(if-lldp-agent)#exit
```

set lldp locally-assigned

Use this command to set the locally assigned name for LLDP interface.

Use no form of this command to remove the locally assigned name for LLDP interface.

Command Syntax

```
set lldp locally-assigned NAME
no set lldp locally-assigned NAME
```

Parameters

NAME	Name assigned to the port.

Command Mode

Interface Mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#set lldp locally-assigned port1
(config-if)#no set lldp locally-assigned
```

set lldp management-address-tlv

Use this command to set the sub type of the Management Address TLV.

Use `no` form of this command to unset the sub type of the Management Address TLV.

Command Syntax

```
set lldp management-address-tlv (mac-address | ip-address)
no set lldp management-address-tlv
```

Parameters

`mac-address`	Use the MAC address as the Management Address.
`ip-address`	Use the management IP address as the Management Address.

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp management-address-tlv ip-address
(if-lldp-agent)#no set lldp management-address-tlv
```

set lldp med-devtype

Use this command to configure the LLDP device type as Network-Connectivity/ End-Point Class1/ End-Point Class2/ End-Point Class3 device.

Use the `no` parameter to un set the configured LLDP device type.

Command Syntax

```
set lldp med-devtype (net-connect| ep-class1| ep-class2| ep-class3)
no lldp med-devtype (net-connect| ep-class1| ep-class2| ep-class3)
```

Parameters

`net-connect`	Set device type as Network-Connectivity
`ep-class1`	Set device type as End-Point Class1
`ep-class2`	Set device type as End-Point Class2
`ep-class3`	Set device type as End-Point Class3

Default

None

Command Mode

Interface mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#set lldp med-devtype ep-class1
(config-if)#exit

#configure terminal
(config)#interface eth0
(config-if)#no set lldp med-devtype
(config-if)#exit
```

set lldp msg-tx-hold

Use this command to set the `msg-tx-hold` parameter that determines the Time To Live (TTL) value for LLDPDUs to be transmitted by the port. The value set with this command is multiplied by the `lldp timer` `msg-tx-interval` value, which determines the final TTL value.

Use `no` form of this command to set the default value of message transmit hold.

Command Syntax

```
set lldp msg-tx-hold <1-100>
no set lldp msg-tx-hold
```

Parameters

`<1-100>`	Time in seconds to set message transmit hold.

Default

The default value of message transmit hold is 4 seconds.

Command Mode

LLDP agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp msg-tx-hold 3
(if-lldp-agent)#no set lldp msg-tx-hold
```

set lldp port-id-tlv

Use this command to set the sub type of the Port ID.

Use `no` form of this command to unset the sub type of the Port ID.

Command Syntax

```
set lldp port-id-tlv (if-alias | ip-address | mac-address | if-name | agt-circuit-
  id | locally-assigned)
no set lldp port-id-tlv
```

Parameters

`mac-address`	Use the MAC address as the port-id-tlv.
`ip-address`	Use the management IP address as the port-id-tlv
`if-alias`	Use the IP alias as the port-id-tlv
`if-name`	Use the interface name as the port-id-tlv
`agt-circuit-id`	Use the agt-circuit-id name as the port-id-tlv
`locally-assigned`	Use the locally assigned value as the port-id-tlv

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp port-id-tlv ip-address
(if-lldp-agent)#no set lldp port-id-tlv
```

set lldp timer

Use this command to set the interval at which LLDP frames are transmitted.

Use `no` form of this command to set the default value for timer.

Command Syntax

```
set lldp timer msg-fast-tx <1-3600>
set lldp timer msg-tx-interval <5-3600>
set lldp timer reinit-delay <1-10>
no set lldp timer msg-fast-tx
no set lldp timer msg-tx-interval
no set lldp timer reinit-Delay
```

Parameters

`msg-fast-tx`	Set the value in range <1-3600>
`msg-tx-interval`	Set the value in range <5-3600>
`reinit-delay`	Set the value in range <1-10>

Default Values

The default value for `msg-fast-tx` is 1 second.

The default value for `msg-tx-interval` is 30 seconds.

The default value for `reinit-delay` is 2 seconds.

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp timer msg-fast-tx 40
(if-lldp-agent)#no set lldp timer msg-fast-tx
(if-lldp-agent)#exit

#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp timer msg-tx-interval 40
(if-lldp-agent)#no set lldp timer msg-tx-interval
(if-lldp-agent)#exit
```

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp timer reinitDelay 3
(if-lldp-agent)#no set lldp timer reinitDelay
(if-lldp-agent)#exit
```

set lldp too-many-neighbors

Use this command to set the action to take when the remote table is full.

Use no form of this command to unset too many neighbors parameters.

Command Syntax

```
set lldp too-many-neighbors limit <1-65535> discard received-info timer <1-65535>
set lldp too-many-neighbors limit <1-65535> discard existing-info MAC timer <1-65535>
no set lldp too-many-neighbors limit
```

Parameters

`limit`	The limit on the number of LLDP neighbors.
`<1-65535>`	Upper limit for the number of Remote LLDP Information.
`received-info`	The information received for this neighbor.
`timer`	The period after which received information is discarded.
`<1-65535>`	The period in seconds after which received information is discarded.
`existing-info`	The information for this neighbor.
`MAC`	Identifies the remote LLDP Agent for which information is discarded.
`timer`	The period in seconds after which existing information is discarded.
`<1-65535>`	The period in seconds after which existing information is discarded.

Default Value

No upper limit is enforced for the number of remote LLDP agents.

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth1
(config-if)#lldp-agent
(if-lldp-agent)#set lldp too-many-neighbors limit 20 disc existing-info
1001.1001.1001 timer 1

(config)#interface eth1
(config-if)#lldp-agent
(if-lldp-agent)#set lldp too-many-neighbors limit 1 discard received-info
timer 1
```

set lldp tx-fast-init

Use this command to determine the maximum value of LLDP frames that are transmitted during a fast transmission period.

Use `no` form of this command to set fast transmission period to default value.

Command Syntax

```
set lldp tx-fast-init <1-8>
no set lldp tx-fast-init
```

Parameters

`tx-fast-init`	Set the message transmit interval value <1-8>.

Default Value

Default value is 4.

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)#lldp-agent
(if-lldp-agent)#set lldp tx-fast-init 4
(if-lldp-agent)#no set lldp tx-fast-init
(if-lldp-agent)#exit
```

set lldp tx-max-credit

Use this command to set the maximum value of transmission credit, which signifies the number of consecutive LLDP frames transmitted.

Use `no` form of this command to set the maximum value of transmission credit to default value.

Command Syntax

```
set lldp tx-max-credit <1-10>
no set lldp tx-max-credit
```

Parameters

`tx-max-credit`	The maximum value of transmission credit.

Default Value

Default value is 5

Command Mode

LLDP Agent mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
#configure terminal
(config)#interface eth0
(config-if)lldp-agent
(if-lldp-agent)#set lldp tx-max-credit <1-10>
(if-lldp-agent)#no set lldp tx-max-credit
(if-lldp-agent)#exit
```

show debugging lldp

Use this command to display LLDP debugging information.

Command Syntax

```
show debugging lldp
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

The following sample output displays information about an LLDP debugging.

```
#show debugging lldp
LLDP debugging status:
 LLDP message debugging is on
```

show lldp neighbors

Use this command to display LLDP neighbors information.

Command Syntax

```
show lldp (nearest-bridge| non-tpmr-bridge| customer-bridge|) neighbors
  (brief|details)
```

Parameters

`nearest-bridge`	Display LLDP nearest bridge information
`non-tpmr-bridge`	Display LLDP non-TPMR-bridge information
`customer-bridge`	Display LLDP customer-bridge information
`neighbor`	Neighbor
`brief`	Brief
`details`	Details

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3 and changed in OcNOS version 1.3.1.

Example

The following sample output displays information about an LLDP neighbors

```
#sh lldp nearest-bridgr neighbors brief
Loc PortID  Rem Host Name   Rem Chassis Id  Rem Port Id   Agent Mode

-------------------------------------------------------------------------------
xe3/1        OcNOS       ecf4.bbfe.2864  ecf4.bbb2.4c65 Nearest bridge


#show lldp neighbors detail

-------------------------------------------------------------------------------
Nearest bridge Neighbors
 Interface Name : xe11
 Mandatory TLVs
 Chassis id type : MAC address [8cea.1b67.236c]
 Port id type : MAC address [8cea.1b28.4f6d]
 Time to live : 121
 Basic Management TLVs
 System Name : OcNOS
 System Description : Hardware Model:EC_AS5912-54X, Software version: OcNOS,1.3.1.122
 Port Description : xe11
 Remote System Capabilities : Bridge Router
 Capabilities Enabled : Router
```

```
Management Address : MAC Address [8cea.1b67.236c]
Interface Number subtype : ifindex
Interface Number : 10011
OID Number : 0
802.1 Org specific TLVs
Port vlan id : 0
Port & Protocol vlan id : 0
Remote Configured VLANs : None
Remote Protocols Advertised: None
Remote VID Usage Digest : 0
Remote Management Vlan : 0
Link Aggregation Capability: capable of being aggregated
Link Aggregation Status : not currently in aggregation
Link Aggregation Port ID :
802.3 Org specific TLVs
AutoNego Support : Supported
AutoNego Status : Disabled
AutoNego Capability : 16
Operational MAU Type : 54 [Four-pair Category 6A or better, full duplex mode only]
Max Frame Size : 1518
```

Table 12-30 Shows the output details.

Table 12-29: show lldp neighbor output details

Entry	Description
Loc Port ID	Local interface SNMP index (appears when the interface option is used).
Rem Host Name	Name of the remote host.
Rem Chassis Id	Remote chassis identifier of the chassis type listed.
Rem Port Id	Remote port identifier of the port type listed.
Agent Mode	Agent mode enabled to the nearest bridge.
Time to live	Number of seconds for which this information is valid.
Interface Name	Name of the interface.
Chassis id type	Chassis identifier of the chassis type listed.
Port id type	Type of port identifier supplied, such as Locally assigned.
System Name	Name supplied by the system on the interface.
System Description	Description supplied by the system on the interface.
Port Description	The port description field uses the configured port description, the port name or the SNMP if Index (appears when the interface option is used).
Remote System Capabilities	Remote system capabilities (such as Bridge, Bridge Router, and Bridge Telephone) that are supported.

Table 12-29: show lldp neighbor output details

Entry	Description
Capabilities Enabled	Enabled by the system on the interface (appears when the interface option is used).
Management Address	Details of management address (such as 10.204.35.34).
Interface Number subtype	Interfaces subtype for which neighbor information is available.
Interface Number	Interfaces for which neighbor information is available.
OID Number	Number of identifier.
Port VLAN ID	Details of the port VLAN identifier.
Protocol VLAN ID	Details of the protocol VLAN identifier.
Remote Configured VLANs	Details of the remote configured VLAN.
Remote Protocols Advertised	Details of the remote protocols.
Remote VID usage Digest	Details of the VID usage.
Remote Management VLAN	Details of the management VLAN.
Link Aggregation Capability	Capabilities that supported by the link aggregation on the interface.
Link Aggregation Status	Status of the link aggregation.
Link Aggregation Port ID	Details of the link aggregation port identifier.
Auto Nego Support	Support of the auto nego on the interface.
Auto Nego Status	Status of the auto nego.
Auto Nego Capability	Capabilities that supported by the auto nego on the interface.
Operational MAU Type	Type of operational MAU on the interface.
Max Frame Size	Maximum frame size on the transit.

show lldp interface

Use this command to display LLDP interface information.

Command Syntax

```
show lldp interface IFNAME (nearest-bridge| non-tpmr-bridge| customer-bridge | )
  (neighbor| )
```

Parameters

`IFNAME`

Display LLDP interface information for all agent

`nearest-bridge`

Display LLDP nearest bridge information

`non-TPMR-bridge`

Display LLDP non-TPMR-bridge information

`customer-bridge`

Display LLDP customer-bridge information

`neighbor`

Display LLDP neighbor details.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced before OcNOS version 1.3.

Example

```
#show lldp interface eth0
Agent Mode : Customer-bridge
Enable (tx/rx): N/N
MED Enabled :N
Device Type: NOT_DEFINED
LLDP Agent traffic statistics:
Total frames transmitted: 0
Total entries aged: 0
Total frames recieved: 0
Total frames received in error: 0
Total frames discarded: 0
Total discarded TLVs: 0
Total unrecognised TLVs: 0

Agent Mode : Non-TPMR-bridge
Enable (tx/rx): N/N
MED Enabled :N
Device Type: NOT_DEFINED
LLDP Agent traffic statistics:
Total frames transmitted: 0
```

```
Total entries aged: 0
Total frames recieved: 0
Total frames received in error: 0
Total frames discarded: 0
Total discarded TLVs: 0
Total unrecognised TLVs: 0

Agent Mode : Nearest bridge
Enable (tx/rx): Y/Y
MED Enabled :N
Device Type: NOT_DEFINED
LLDP Agent traffic statistics:
Total frames transmitted: 2495
Total entries aged: 0
Total frames recieved: 0
Total frames received in error: 0
Total frames discarded: 0
Total discarded TLVs: 0
Total unrecognised TLVs: 0
```

Table 12-30 Shows the output details.

Table 12-30: show lldp interface output details

Entry	Description
Agent Mode	Agent mode enabled to the customer-bridge, Non-TPMR-bridge, and nearest bridge.
Enable (tx/rx)	Enables the transmit and receive on the interface.
Device Type	Type of device in the networks.
LLDP Agent traffic statistics	Statistics on exchanged LLDP frames between a device and neighbors.
Total frames transmitted	Number of frames transmitted in network.
Total entries aged	Number of aged entries in a networks.
Total frames received	Number of frames received from the neighbor network.
Total frames received in error	Number of frames not received from the neighbor network.
Total discarded TLVs	Number of TLVs discarded in transit.
Total unrecognised TLVs	Number of unrecognised TLVs in transit.

snmp restart lldp

Use this command to restart SNMP in Link Layer Discovery Protocol (LLDP)

Command Syntax

```
snmp restart lldp
```

Parameters

None

Command Mode

Configure mode

Applicability

This command was introduced before OcNOS version 1.3.

Examples

```
(config)#snmp restart lldp
```

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